

**TECHNICAL MANUAL**

**FIELD MAINTENANCE INSTRUCTIONS  
WITH  
OVERHAUL DATA**

**RADIO SET  
AN/ARC-105  
CPN 522-3410-00**

**Collins Radio Group/Rockwell International**

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## INTRODUCTION

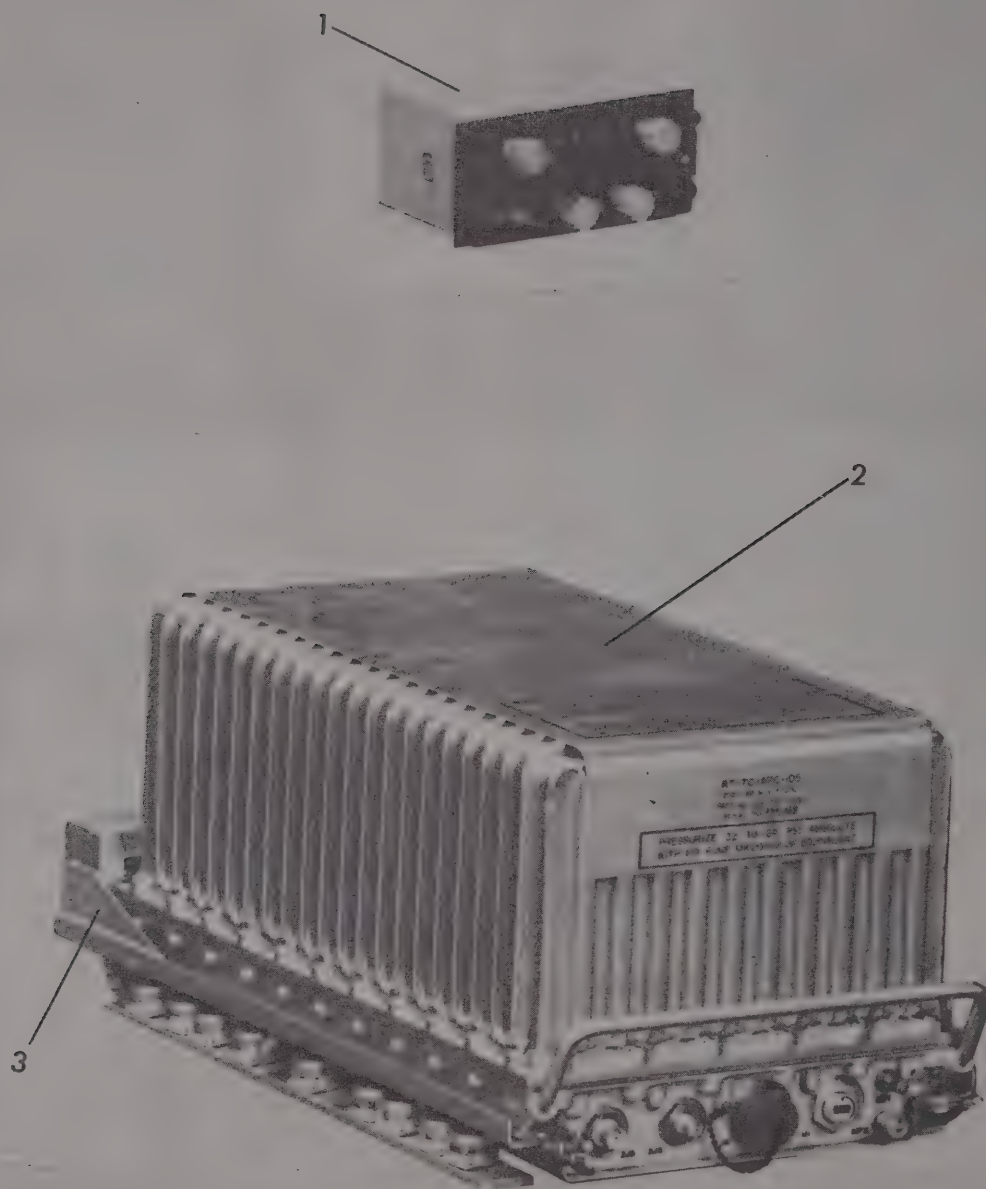
This technical manual contains field maintenance and overhaul instructions for personnel servicing Radio Receiver-Transmitter RT-712/ARC-105, Radio Set Control C-4958/ARC-105, and Mounting MT-3094/ARC-105. For brevity, this equipment will be referred to as the HF Radio Set. Maintenance and overhaul instructions for Antenna Coupler CU-1239/ARC-105 and its associated equipment, Antenna Coupler Group OF-17/ARC-105, and Antenna Coupler Group ACG-101 can be found in TO 12R2-2ARC105-2, NAVAIR 16-350F17-1, and TO 12R2-4-1-102 respectively. The manual is prepared in accordance with the general style and format requirements contained in specification MIL-M-5474. The technical content of the manual has been organized in accordance with specification MIL-H-25095 (USAF), Field Maintenance Instructions, and expanded to include overhaul information in accordance with MIL-H-6814A (ASG). Overhaul instructions include those procedures required for use by depot maintenance personnel to supplement the field maintenance instructions to the extent necessary to afford complete maintenance of the equipment. The illustrated parts breakdown for Radio Set AN/ARC-105, Antenna Coupler CU-1239/ARC-105 and its associated equipment, Antenna Coupler Group OF-17/ARC-105, and Antenna Coupler Group ACG-101 are provided in TO 12R2-2ARC105-14, TO 12R2-2ARC105-4, NAVAIR 16-350F17-2, and TO 12R2-4-1-104, respectively.

Applicable specifications are as follows:

MIL-H-6814A (ASG) Technical Manuals, Overhaul (Electronic, Electrical, Electro-Hydraulic, Electro-Mechanical Equipments, Systems, and Test Equipment); Preparation of

MIL-H-25095 (USAF)	Technical Manuals: Field Maintenance Instructions (for Airborne Electronic Equipment)
MIL-M-5474	Technical Manuals, General Requirements for Preparation of
MIL-STD-12	Abbreviations for Use on Drawings and in Technical Type Publications
USAS Y.32.2	Electrical and Electronic Symbols
USAS Y.32.16	Electrical and Electronic Reference Designations
MIL-STD-681	Identification Coding and Application of Hookup Wire
MIL-L-6880	Lubrication of Aircraft, General Specifications for

The HF Radio Set is modular in construction for the most part. Parts located in modules are designated by a compound reference designator such as 2A1R2, when 2 is the unit, A1 is the module, and R2 is the detail part. Parts located on submodules are designated by a compound designator such as 2A12A2C3; where 2 is the unit, A12 is the module, A2 is the submodule, and C3 is the detail part.



TPI-9307-017

Figure 1-1. HF Radio Set

## SECTION I

### DESCRIPTION AND LEADING PARTICULARS

#### 1-1. SCOPE OF TECHNICAL MANUAL.

1-2. This publication contains field maintenance and overhaul instructions for Radio Receiver-Transmitter RT-712/ARC-105, Radio Set Control C-4958/ARC-

105, and Mounting Radio Receiver-Transmitter MT-3094/ARC-105. This section contains an account of the equipment purpose, a description of the components, and condensed factual data. The illustrations and tables in this section are as follows:

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#### 1-3. PURPOSE OF EQUIPMENT.

1-4. The HF Radio Set (refer to figure 1-1) provides facilities for communication between aircraft and fixed or mobile ground communication stations. It transmits and receives voice communications in the HF band (2 to 29.999 MHz) and may be operated at any of 28,000 separate channels spaced 1 KHZ apart. The modes of operation are upper sideband (USB), lower sideband (LSB), and amplitude modulation

(AM). Power output is 400 watts PEP in the single-sideband modes and 125 watts in the amplitude modulation mode.

#### 1-5. EQUIPMENT SUPPLIED.

1-6. For a list of equipment supplied with the HF Radio Set, refer to figure 1-2 which includes the official nomenclature, common name, and description of the items of equipment supplied. The items supplied with the HF Radio Set are illustrated in figure 1-1.

FIG 1-1 INDEX NO	OFFICIAL NOMENCLATURE	COMMON NAME	OVERALL DIMENSIONS (IN)			WEIGHT (LB)
			HEIGHT	WIDTH	DEPTH	
2	Radio Receiver-Transmitter RT-712/ARC-105	Radio receiver-transmitter	10.25	11.44	22.77	66.0
1	Radio Set Control C-4958/ ARC-105	Radio set control	2.63	5.75	4.88	2.0
3	Mounting MT-3094/ ARC-105	Radio receiver-transmitter mounting	5.23	12.19	24.98	6.5

Figure 1-2. Equipment Supplied

#### NOTE

Refer to TO 12R2-2ARC105-2 for field maintenance and overhaul instructions for Antenna Coupler CU-1239/ARC-105, Antenna Coupler Control C-4959/ARC-105, Mounting MT-3095/ARC-105, Vacuum Dielectric Variable Capacitor MX-6066/ARC-105, Capacitor Feedline MX-6067/ARC-105, Capacitor Interconnect MS-6068/ARC-105, and RF Transmission Line CG-2755/ARC-105. Refer to NAVAIR 16-35OF17-1 and TO 12R2-4-1-102 for field maintenance and overhaul instructions for Antenna Coupler Group OF-17/ARC-105 and Antenna Coupler Group ACG-101 respectively.

#### 1-7. EQUIPMENT REQUIRED BUT NOT SUPPLIED.

1-8. Refer to figure 1-3 for a list of equipment required for operation but not supplied as part of the HF Radio Set.

#### 1-9. DESCRIPTION OF COMPONENTS.

1-10. The HF Radio Set is composed of three components: Radio Receiver-Transmitter RT-712/ARC-

105, Mounting MT-3094/ARC-105, and Radio Set Control C-4958/ARC-105. These components are described in the following paragraphs.

#### 1-11. RADIO SET CONTROL.

1-12. The radio set control (unit 1), figure 1-4, is a remote control unit that is installed at the operator's location. It enables the operator to select manually the mode and frequency of operation. A digital readout of the frequency selected is provided. The RF SENS control adjusts the receiver sensitivity and provides monitoring for the condition of the internal circuit of the receiver-transmitter.

1-13. The radio set control is mounted using four Dzus fasteners. All electrical connections are made to one quick-disconnect connector located on the rear of the unit.

#### 1-14. RADIO RECEIVER-TRANSMITTER.

1-15. The radio receiver-transmitter (unit 2), figure 1-1, consists of 10 plug-in modules mounted on a chassis assembly and enclosed in a pressurized case.

QUANTITY PER EQUIPMENT	AN NOMENCLATURE		REQUIRED CHARACTERISTICS
	NAME	TYPE	
1	Microphone	T-17D	Carbon, 80 to 100 ohms.
1	Headset	HS-33A	High impedance.
1	Antenna coupler		Capable of matching radio receiver-transmitter 52-ohm output impedance to antenna impedance with vswr of 1.3:1 or less.
1	Antenna		Governed by installation requirements.

Figure 1-3. Equipment Required But Not Supplied

The module complement of the radio receiver-transmitter is listed in figure 1-5.

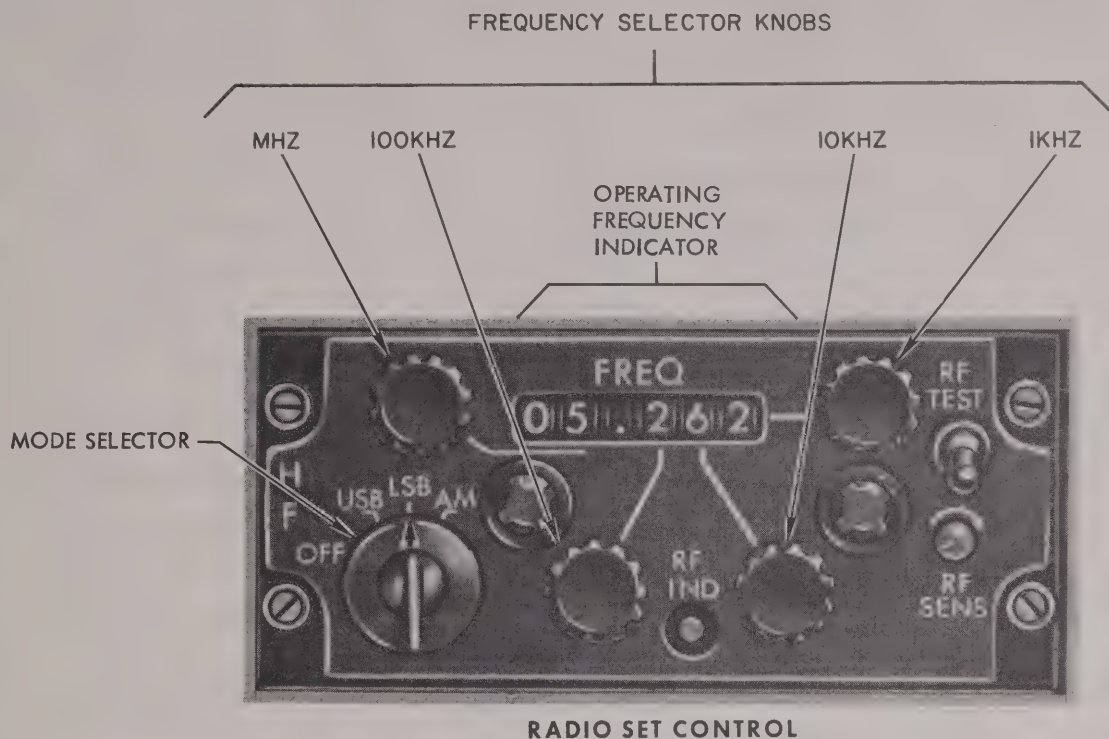
All electrical connections between the modules and the chassis assembly are made through multipin plugs on the module to mating connectors mounted on the chassis assembly. Some intramodule connections are made through coaxial connectors. All modules are securely fastened to the chassis by captive hold-down screws. Two module pullers are supplied as part of the radio receiver-transmitter to facilitate module removal. In addition to providing a mounting base for the plug-in modules, the chassis assembly contains and supports the required intramodule wiring, the transmit/receive relays, and the internal blower.

1-16. The front panel contains a type C coaxial connector that is used to connect the transmitter output

to the antenna coupler, a BNC coaxial connector for auxiliary connection of the receiver input circuits to a separate receive antenna, and a 26-pin jack used for connection of test equipment. In addition, a digital nonresettable elapsed time meter (calibrated in hours), pressure relief valve, and pneumatic valve to allow pressurization are provided.

1-17. All power and control wiring connections are made to a 49-pin connector located on the rear of the unit. An external cooling air inlet and outlet are also provided on the rear of the unit.

1-18. The cover is constructed of aluminum and is secured to the chassis by 34 socket head-cap screws. A Teflon gasket, located on the chassis, provides an airtight seal between the cover and the chassis.



RADIO SET CONTROL	
CONTROL OR INDICATOR	FUNCTION
MODE SELECTOR	RADIO SET-OFF CONTROL AND OPERATING-MODE SELECTOR
OPERATING-FREQUENCY SELECTORS MHZ 100-KHZ 10-KHZ 1-KHZ	SELECT RADIO SET OPERATING FREQUENCY.
OPERATING-FREQUENCY INDICATOR	PROVIDES DIGITAL READOUT OF RADIO SET OPERATING FREQUENCY
RF SENS	CONTROLS RECEIVER RF SENSITIVITY
RF TESTS	SWITCHES RADIO SET TO AM TRANSMIT MODE TO PROVIDE TRANSMITTER TEST SIGNAL
RF IND	INDICATES PRESENCE OF RF AT ANTENNA. ALSO INDICATES ANTENNA COUPLER TUNING FAULT OR PRESENCE OF EXCESSIVE SWR DURING TRANSMIT OPERATION.

F4JM/HFC-86

Figure 1-4. Radio Set Control, Front Panel

MODULE	FUNCTIONAL NAME	COLLINS PART NUMBER
	Chassis assembly	554-4051-005
2A1	Frequency divider	528-0448-00
2A2	Radio-frequency oscillator	528-0419-005
2A3	Intermediate frequency amplifier	528-0440-005
2A4	KC frequency stabilizer	528-0285-005
2A6	Electronic control amplifier	528-0315-005
2A7	Power supply	528-0446-005
2A9	Audio amplifier	528-0442-005
2A10	MC frequency stabilizer	528-0272-026
2A11	Power amplifier	528-0441-005
2A12	Radio-frequency translator	528-0443-005
2A12A1	Autopositioner (submodule)	528-0444-005
2A12A2	Variable frequency oscillator (VFO) (submodule)	522-3552-015

Figure 1-5. Radio Receiver-Transmitter Module Complement

1-19. RADIO RECEIVER-TRANSMITTER MOUNTING.

1-20. The radio receiver-transmitter mounting (unit 3), figure 1-1, provides an electrical and mechanical interface between the radio receiver-transmitter and the aircraft. Vibration isolators protect the radio receiver-transmitter from damage that would be caused by shock or vibration. A secure mount for the radio receiver-transmitter is ensured by two receptacles for the radio receiver-transmitter locat-

ting pins and two quick disconnect captive front clamps. The mounting also contains a heat exchanger with input and exhaust orifices for cooling air.

**1-21. CONDENSED FACTUAL DATA.**

1-22. EQUIPMENT CHARACTERISTICS.

1-23. Refer to figure 1-6 for a tabulation of equipment characteristics of the HF Radio Set. Specifications

TECHNICAL CHARACTERISTIC	SPECIFICATION
GENERAL	
Environmental condition	
Operating	0 to 60,000 feet in a temperature environment up to +71 °C (+158 °F) when supplied with cooling air.
Nonoperating	-65 °C to +25 °C (-85 °F to +185 °F).

Figure 1-6. Equipment Characteristics (Sheet 1 of 3)

TECHNICAL CHARACTERISTIC	SPECIFICATION
GENERAL (Cont)	
Primary power required	115 volt, 3-phase (line to neutral), 4-wire, 380- to 420-HZ, 1000-watt maximum.
Remote control	Operation to a distance of 150 feet.
Warmup and stabilization time	Fully operational within 15 minutes from turn-on.
Duty cycle	5 minutes transmit, 5 minutes receive.
Frequency range	2.000 to 29.999 MHZ, spaced at 1-KHZ intervals.
Frequency channels	28,000.
Stability	0.8 part per million per month.
RECEIVER SECTION	
Types of emission	USB, LSB, and AM.
RF input impedance	52 ohms unbalanced.
Sensitivity	USB and LSB: 1 UV for 10 DB (S+N)/N ratio.  AM: 3 UV, 30 percent modulated with 1000 HZ for 6 DB (S+N)/N ratio.
Selectivity	USB and LSB: Not more than 5 DB down at 300 and 3000 HZ.  Not less than 15 DB down at 0 and 3500 HZ.  Not less than 60 DB down at 1350 and 4650 HZ.  AM: Bandwidth = 6 KHZ minimum at 6-DB points, 14 KHZ maximum at 60-DB points.
IF rejection	80-DB minimum.
Demodulation method	USB and LSB: product detector.  AM: envelope detector.
Audio frequency response	300 to 3000 HZ $\pm$ 5 DB.
Audio output impedance	300 ohms unbalanced.
Audio output power	50-MV with 5-UV RF input.
Audio distortion	10 percent maximum at 80 percent modulation, 1000 HZ.
Agc characteristics	Audio output variation 6 DB maximum with RF input variation from 10 to 100,000 UV. No blocking with signals to 0.5 volt.

Figure 1-6. Equipment Characteristics (Sheet 2 of 3)

TECHNICAL CHARACTERISTIC	SPECIFICATION
TRANSMITTER SECTION	
Types of emission	USB, LSB, and AM.
Audio input impedance	100 ohms unbalanced.
Audio input level	0.1 volt RMS at 100-ohm input for 85 percent modulation minimum in AM mode.
Audio frequency response	300 to 3000 HZ $\pm 5$ DB.
Modulation method	Low-level balanced modulator. Carrier reinserted for AM.
Modulation capabilities	85 percent minimum in AM mode.
RF output power	USB and LSB: 400 watts PEP, $\pm 2$ DB.
RF output impedance	52 ohms, unbalanced, with VSWR of 1.3:1.

Figure 1-6. Equipment Characteristics (Sheet 3 of 3)

are included for input power requirements, functional characteristics, and environmental conditions for operating or servicing the equipment.

#### 1-24. TUBE AND TRANSISTOR COMPLEMENT.

1-25. The tube and transistor complement for the HF Radio Set is contained in figure 1-7.

#### 1-26. CRYSTAL COMPLEMENT.

1-27. Only one discrete component crystal is used in the HF Radio Set. This crystal is employed as the master oscillator and is contained in a subassembly of RF oscillator 2A2. This subassembly is nonrepairable at field or depot maintenance levels and should be returned to the contractor for repair.

LOCATION	SYMBOL	TYPE	FUNCTION
Radio receiver-transmitter chassis assembly	Q1	2N491	Time delay gate
	Q2	2N888	Sidetone gate
Frequency divider 2A1	Q1	2N706	Amplifier
	Q2	2N1302	Pulse generator
	Q3	2N1302	Pulse generator
	Q4	2N1303	Pulse amplifier
	Q5	2N1303	Pulse amplifier
	Q6	2N1303	Pulse amplifier
	Q7	2N706	Emitter follower
(Cont)			

Figure 1-7. Tube and Transistor Complement (Sheet 1 of 4)

LOCATION	SYMBOL	TYPE	FUNCTION
Frequency divider 2A1 (Cont)	Q8	2N1303	Pulse amplifier
	Q9	2N1302	Pulse amplifier
	Q10	2N404	Keyer
	Q11	2N404	Keyer
	Q12	2N3135	Keyed oscillator
RF oscillator 2A2	Q1, Q2, Q3		Contained in nonrepairable unit (temperature compensated crystal oscillator)
	Q4	2N703	Locked oscillator
	Q5	2N703	500-KHZ amplifier
	Q6	2N703	500-KHZ amplifier
	Q7	2N703	Emitter follower
	Q8	2N703	Locked oscillator
	Q9	2N703	100-KHZ output amplifier
IF translator 2A3	Q1	2N4416	ALC amplifier
	Q2	2N3135	IF amplifier
	Q3	2N3135	IF amplifier
	Q4	2N3135	IF amplifier
	Q5	2N3135	IF amplifier
	Q5	2N542	TGC-ADC amplifier
KC frequency stabilizer 2A4  (Cont)	Q1	2N3135	Isolation amplifier
	Q2	2N3135	First mixer
	Q3	2N3135	Second mixer
	Q4	2N3135	Isolation amplifier
	Q5	2N3135	IF amplifier
	Q6	2N3135	IF amplifier
	Q7	2N3135	IF amplifier
	Q8	2N3135	IF amplifier
	Q9	JAN 2N333	10-KHZ keyer

Figure 1-7. Tube and Transistor Complement (Sheet 2 of 4)

LOCATION	SYMBOL	TYPE	FUNCTION
KC frequency stabilizer 2A4 (Cont)	Q10	USA 2N706	10-KHZ keyer
	Q11	JAN 2N128	Keyed oscillator
	Q12	2N3135	Digit oscillator
	Q14	2N3135	Isolation amplifier
	Q15	2N3135	Reference mixer
	Q16	2N3135	Reference IF amplifier
	Q17	2N3135	Reference IF amplifier
	Q18	2N3135	Reference IF amplifier
	Q19	2N3135	Reference IF amplifier
Electronic control amplifier 2A6	Q1	JAN 2N652	Amplifier
	Q2	JAN 2N652	Amplifier
	Q3	JAN 2N652	Amplifier
	Q4	JAN 2N652	Amplifier
	Q5	USA 2N457	Phase inverter
	Q6, Q7	USA 2N457 A	Push-pull amplifier
Power supply 2A7	Q1	2N1485	Regulator
	Q2	2N1132	DC amplifier
	Q3	2N697	DC amplifier
	Q4	2N1485	Regulator
	Q5	2N1132	DC amplifier
	Q6	2N697	DC amplifier
AM/audio amplifier 2A9	Q1	2N158	Audio amplifier
	Q2	2N158	Audio amplifier
	Q3	2N3135	IF amplifier
	Q4	2N3135	IF amplifier
	Q5	2N3135	IF amplifier
	Q6	2N3135	IF amplifier
	Q7	2N3135	AGC amplifier
	Q8	2N651	Audio preamplifier
	Q9	2N651	Audio amplifier

Figure 1-7. Tube and Transistor Complement (Sheet 3 of 4)

LOCATION	SYMBOL	TYPE	FUNCTION
MC frequency stabilizer 2A10	Q3	USAF-2N489	17.5 MHZ recycle
	Q4	USAF-2N489	8.5 - 16 MHZ recycle
17.5-MHZ amplifier subassembly 2A10A1	Q1	2N3323	RF amplifier
	Q2	USA 2N706	RF amplifier
	Q3	USA 2N706	Mixer
	Q4	2N3323	IF amplifier
8.5- to 16-MHZ amplifier subassembly 2A10A2	Q1	2N3323	RF amplifier
	Q2	USA 2N706	RF amplifier
	Q3	USA 2N706	Mixer
	Q4	2N3323	IF amplifier
Spectrum generator subassembly 2A10	Q1	USA 2N706	Squaring amplifier
	Q2	2N2218	Pulse generator
Power amplifier 2A11	V1	7204	Power amplifier
	V2	7204	Power amplifier
RF translator 2A12	V1	12AT7WA	Mixer
	V2	12AT7WA	Mixer
	V3	12AT7WA	Mixer
	V4	6DC6	RF amplifier
	V5	6DC6	RF amplifier
	V6	6CL6	Driver
	V7	6CL6	Driver
	V8	6AH6WA	Mixer
	V9	6AH6WA	Mixer
	V10	6AH6WA	17.5 MHZ oscillator
	V11	6AH6WA	HF oscillator
	V12	12AT7WA	Mixer
Variable frequency oscillator 2A12A2	Q1, Q2, Q3, Q4		Contained in nonrepairable item

Figure 1-7. Tube and Transistor Complement (Sheet 4 of 4)

**1-28. FUSE COMPLEMENT.**

1-29. The fuse complement for the HF Radio Set is contained in figure 1-8. The quantity listed excludes the spare fuses supplied with the equipment.

**1-30. OPERATING CONTROLS AND INDICATORS.**

1-31. All controls used during normal operation of the HF Radio Set are located on the radio set control. Figure 1-4 shows the location of the controls and

QUANTITY	TYPE NUMBER	AMPERE RATING	SYMBOL
2	275-375	3/8	2A7F1, 2A7F2

Figure 1-8. Fuse Complement

indicators on the radio set control. The functions of the controls and indicators are described in figure 1-9. The controls and indicators mounted on the radio receiver-transmitter are intended for maintenance use only.

**1-32. OPERATING PROCEDURES.**

1-33. The sequence of operation of the HF Radio Set is as follows:

a. Rotate the mode selector to the desired operating mode.



Ensure that area around antenna is clear of personnel before operating the HF Radio Set as RF burns may result.

b. Select the desired operating frequency using the four frequency select controls. The radio receiver-transmitter will mute, indicating it is setting up to the new frequency.

**NOTE**

If the mode select control was moved from the OFF position to an operating mode and the desired operating frequency was already set up on the radio set control, rotate the 10-KHZ select control one digit off frequency and then back to the operating frequency. This will ensure that the system retunes to the exact frequency.

c. When the radio receiver-transmitter is no longer muted, actuate the push-to-talk switch momentarily, and wait for the radio receiver-transmitter and the antenna coupler to tune. A 1000-HZ tone will be heard in the headphones until tuning is complete.

d. When the radio receiver-transmitter is tuned, adjust the RF SENS control so the noise in the headphones is barely audible.

e. If a crew member has control of the audio level fed to the earphones by use of a control other than the RF SENS control, the two controls must be adjusted to obtain the best signal-to-noise ratio. The RF SENS control must be set high enough to receive signals which are just above the noise level. The audio gain is then adjusted to bring the audio to a comfortable listening level. Proper balance is indicated when antenna white noise (background noise) is just audible and a weak signal is raised to a comfortable listening level.

CONTROL OR INDICATOR	DESCRIPTION	FUNCTION
RADIO SET CONTROL C-4958/ARC-105		
Mode selector	Wafer switch	Selects desired operational mode.
MHZ select control	28-position wafer switch	Selects desired MHZ increment for radio receiver-transmitter operation.
100-KHZ select control	10-position wafer switch	Selects desired 100-KHZ increment for radio receiver-transmitter operation.
10-KHZ select control	10-position wafer switch	Selects desired 10-KHZ increment for radio receiver-transmitter operation.
1-KHZ select control	10-position wafer switch	Selects desired 1-KHZ increments for radio receiver-transmitter operation.
FREQ indicator	Mechanical digital indicator	Provides numerical display of selected frequency from 2.000 to 29.999 MHZ in 1-KHZ increments.
RF SENS control	Potentiometer 1R1	Adjusts RF sensitivity of the receiver.
RF TEST switch	Push-button switch	Switches radio receiver-transmitter to transmit in the AM mode to provide a transmitter test signal.
RF IND lamp	Indicator lamp	Indicates presence of RF at antenna. Also, indicates antenna coupler tuning fault or presence of excessive VSWR during transmit operation.
RADIO RECEIVER-TRANSMITTER RT-712/ARC-105		
Meter M1	Elapsed time meter	Provides visual indication of length of time (in hours) that radio receiver-transmitter has been operated.

Figure 1-9. Operating Controls and Indicators



## SECTION II

### PREPARATION FOR MAINTENANCE

#### 2-1. GENERAL.

2-2. This section contains instructions for preparing the HF Radio Set for maintenance. The maintenance procedures are described in sections VII, VIII, and IX. Figure 2-1, Basic Test Setup Diagram, page 2-2, is the only illustration used in this section.

#### 2-3. RADIO RECEIVER-TRANSMITTER.

#### 2-4. PREPARATION FOR MAINTENANCE.

2-5. Prepare the radio receiver-transmitter for maintenance as follows:

#### CAUTION

Depressurize the unit by depressing the stem in the pressure valve on the front panel.

- a. Remove the 34 socket-head capscrews holding the cover to the chassis.
- b. Break the seal by gently tapping the sides of the cover with an upward motion of the hands. All modules of the radio receiver-transmitter are now accessible.

#### CAUTION

Do not attempt to separate the cover from the chassis by prying the two apart. This will damage the sealing surfaces. Cover the sealing surfaces with tape to prevent damage to the surfaces.

- c. The modules are removed by loosening the captive screws that secure the modules to the chassis, attaching one of the module pullers supplied as part of the radio receiver-transmitter for modules 2A1 through 2A11 or both of the module pullers if module 2A12 is to be removed, and pulling straight out.

#### CAUTION

Do not twist or pry on module to disengage mating connectors or connectors may be damaged.

- d. Remove the dust covers from modules 2A1 through 2A10 and 2A12 by pulling the handle or handles that are riveted to the dust cover.

- e. Remove the dust covers from module 2A11 by loosening the 17 screws, and sliding the dust covers free of the key slots.

- f. Perform a thorough visual inspection of all modules, checking for broken wires, mechanical wear, and burned-out detail parts.

- g. Repair the modules or replace with spares known to be good.

- h. Install all dust covers on the modules, and install them on the chassis. The cover need not be replaced.

#### 2-6. TEST SETUP.

2-7. Figure 2-1 is the basic test setup diagram for the module test procedures contained in section VIII. All deviations from this diagram are covered in the test procedures. Test setup information for the minimum performance test procedures of section VI is contained in figures 6-4 through 6-7.

#### NOTE

The cable reference designators used in figure 2-1 and sections VI and VIII are not applicable when Radio Set Test Set AN/ARM-158 is used to test Radio Set AN/ARC-105.

#### 2-8. RADIO SET CONTROL.

#### 2-9. PREPARATION FOR MAINTENANCE.

2-10. Prepare the radio set control for maintenance as follows:

- a. Loosen the two Dzus fasteners to remove the rear cover from the radio set control.

- b. Loosen the Bristo setscrews for all knobs, and remove the knobs.

- c. Remove all panel lamps.

- d. Remove the hardware holding connector 1J1 to the back panel.

- e. Remove the flathead screws connecting the rear and bottom panels, and remove the rear and bottom panels.

- f. Remove the two small flathead screws from the front panel. Lift the front panel overlay from the subpanel.

- g. Remove the flathead screws holding the side panels to the front panel.

- h. Perform a thorough visual inspection of the radio set control checking for broken wires, mechanical wear, and burned-out detail parts.

#### 2-11. TEST SETUP.

2-12. No special test setup is required for the radio set control.

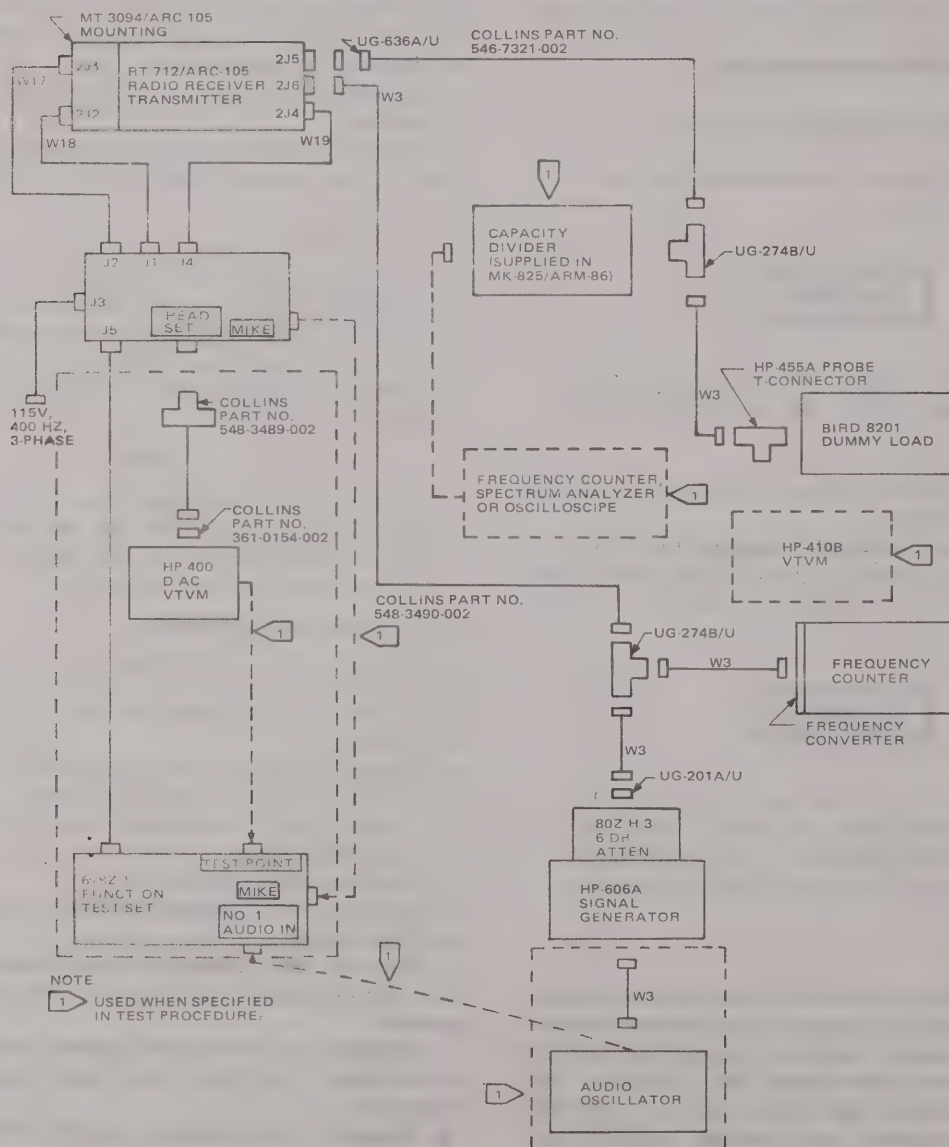
2-13. RADIO RECEIVER-TRANSMITTER MOUNTING.

2-14. PREPARATION FOR MAINTENANCE.

2-15. A thorough visual inspection of the radio-receiver-transmitter mounting is the only preparation for maintenance needed.

2-16. TEST SETUP.

2-17. No special test setup is required for the radio receiver-transmitter mounting.



TP1-8150-012

Figure 2-1. Basic Test Setup Diagram

## SECTION III

### TEST EQUIPMENT AND SPECIAL TOOLS

#### 3-1. GENERAL.

3-2. This section lists all test equipment required to maintain the HF Radio Set. Instruction for proper test equipment usage is described in maintenance sections VII through IX. Common tools (screwdrivers, etc) are not listed. The only illustration used in this section is figure 3-1, Test Equipment Required For Maintenance on page 3-1.

#### 3-3. TEST EQUIPMENT REQUIRED.

3-4. Figure 3-1 contains a list of test equipment required to maintain the HF Radio Set.

#### NOTE

Equivalent test equipment may be used.

#### 3-5. SPECIAL TOOLS REQUIRED.

3-6. Fabrication information for the only special tool required is contained in figure 10-1.

NAME	AN TYPE OR MANUFACTURER DESIGNATION		USE
	Test equipment to be used when Radio Set AN/ARC-105 is used in conjunction with		
	CU-1239/ARC-105 Antenna Coupler or ACG-101 Antenna Coupler Group	OF-17/ARC-105 Antenna Coupler Group supported by AN/ARM-158	
Radio set test set		AN/ARM-158	Interconnect and control facility for Radio Set AN/ARC-105 and Antenna Coupler Group OF-17/ARC-105.
Radio set test harness	TS-2214/ARM-86	* 609-9297-002	Interconnect and control facility for Radio Set AN/ARC-105.
Electronic equipment maintenance kit	MK-825/ARM-86	*	Assist in testing of Radio Receiver-Transmitter RT-712/ARC-105.
Function test set	Collins 678Z-1	*	Assist in testing of Radio Receiver-Transmitter RT-712/ARC-105.
Dummy load	Bird 8201C	*	RF load for Radio Receiver-Transmitter RT-712/ARC-105.
Microphone	T-17D	*	Power output checks.
Headset	HS-33A	*	Audio checks.
Vacuum tube voltmeter	Hewlett-Packard 410B	Hewlett-Packard 410B	Voltage measurements.
Vacuum tube voltmeter	Hewlett-Packard 400D	Hewlett-Packard 400H	Audio frequency voltage measurements.
Voltmeter	Type 340	Hewlett-Packard 400H	Low-level RF voltage measurements.

Figure 3-1. Test Equipment Required for Maintenance (Sheet 1 of 2)

NAME	AN TYPE OR MANUFACTURER DESIGNATION		USE
	Test equipment to be used when Radio Set AN/ARC-105 is used in conjunction with		
	CU-1239/ARC-105 Antenna Coupler or ACG-101 Antenna Coupler Group	OF-17/ARC-105 Antenna Coupler Group supported by AN/ARM-158	
Audio oscillator	Hewlett-Packard 200D	Hewlett-Packard 200CD	Generate audio frequency signals for test purposes.
Signal generator	Hewlett-Packard 606A	Hewlett-Packard 606A	Generate radio frequency signals for test purposes.
6-DB attenuator	Measurements Corp. 80-ZH3	Weinschel 50-6	Provides attenuator for signal generator output.
Probe T-connector	Hewlett-Packard 455A	*	Enables connection of test equipment to RF output line.
Distortion analyzer	Hewlett-Packard 330D	Hewlett-Packard 331A	Measures harmonic distortion.
Spectrum analyzer	SSB-3B	Nelson-Ross (Polarad) PSA-200 (Plug-in)	Provides visual indication of RF spectrum.
Oscilloscope	MIL-O-9960	Tektronix 545B	Visual analysis of various signals.
Preamplifier (Plug-in)	Type CA	Type 1A1	Amplification of input signal to oscilloscope.
Frequency counter	MIL-C-9988	AN/USM-207	Frequency measurement.
Frequency converter	Supplied with MIL-C-9988	Supplied with AN/USM-207	Provides multiplication factor for frequency counter.
Differential voltmeter	MIL-V-9999	Use digital voltmeter; Hewlett-Packard DY2401CM5	Voltage measurement.
Voltohm-meter	Simpson 269	Simpson 260-6P	Continuity checks.
Blower	HVU	* 622-0349-001 HD-930/ARM-158	Provides cooling air for radio receiver-transmitter.
Pressurizing kit	MK-20A/UP	MK-20A/UP	Pressurize radio receiver-transmitter.
Pressure gauge	SV-3715	SV-3715	Pressure measurements of radio receiver-transmitter.
Power supply	John Fluke 407DR	John Fluke 407D	Provides enabling voltage for relays during power supply tests.
Power supply	Hewlett-Packard 6266B	Lambda LH124FM	Power source during power supply tests.
Receiver (optional)	Collins 51S-1	Collins 51S-1	Assist in alternate testing of RF Translator 2A12.
*Equivalent item supplied as part of Radio Set Test Set AN/ARM-158.			

Figure 3-1. Test Equipment Required for Maintenance (Sheet 2 of 2)

## SECTION IV THEORY OF OPERATION

### 4-1. GENERAL.

4-2. This section describes the theory of operation of the HF Radio Set at the functional level. A functional loop is composed of the related modules, assemblies, and aircraft wiring required to perform a specific function within the system. The functional loop discussion is limited to the active components

in the HF Radio Set. The HF Radio Set contains the following three loops: transmit, receive, and mode and frequency selection and control. Detailed circuit analysis for the radio receiver-transmitter and the radio set control is contained in maintenance sections VII and VIII.

4-3. The illustrations and tables in this section are as follows:

Figure	Title	Page
4-1	HF Radio Set, Functional Loop Diagram . . . . .	4-2
4-2	Transmit Loop Diagram . . . . .	4-2
4-3	Receive Loop Diagram . . . . .	4-3
4-4	Mode and Frequency Selection and Control Loop Diagram . . . . .	4-3

### 4-4. SYSTEM OPERATION.

4-5. Figure 4-1 is a functional loop diagram of the HF Radio Set. The HF Radio Set is capable of providing voice communications between aircraft in flight, aircraft and ground installations, and aircraft and shipboard installations in single-sideband (either upper or lower) or amplitude modulation modes. The HF Radio Set is capable of receiving and transmitting on 28,000 discrete channels, spaced 1 KHZ apart, in the high-frequency band of 2,000 to 29,999 MHZ. Mode and frequency of operation are selected by the operator on the radio set control.

### 4-6. TRANSMIT LOOP.

4-7. Figure 4-2 is a diagram of the transmit loop. Voice audio is applied to the microphone and passed to AM/audio amplifier 2A9 where it is amplified in two audio amplifier stages. A portion of the audio is fed to the headset to allow the operator to monitor his transmission. The amplified audio is translated in the balanced modulator to the 500-KHZ injection signal from RF oscillator 2A2, producing a double-sideband signal with a suppressed carrier. The signal is amplified and routed through either the USB or LSB mechanical filter. The proper filter is selected by the mode selector on the radio set control. In the AM mode, the USB filter is selected and the 500-KHZ injection signal is reinserted for use as the carrier. The signal is converted to the operating frequency and amplified to a level sufficient to drive power amplifier 2A11 in RF translator 2A12. Power amplifier 2A11 provides 400 watts PEP in the SSB modes and 125 watts of RF power in the AM mode. The output of power amplifier 2A11 is coupled to an antenna coupler so that the antenna may be driven with minimum VSWR.

### 4-8. RECEIVE LOOP.

4-9. Figure 4-3 is a diagram of the AM/SSB receive loop. The incoming RF signal is amplified and converted to a 500 KC IF signal in the RF translator (2A12 module). In the SSB mode, the 500 KC IF signal is amplified in the IF translator (2A3) and detected to produce its audio component. The audio signal thus produced is applied to the (2A9) audio amplifier module and thence to the radio set audio output wiring terminals. During AM reception the 500 KC IF signal is applied directly to the audio amplifier (2A9 module) where the audio component is detected, amplified and fed to the radio set audio output. A portion of the output of the 2A9 audio module is fed back to the RF translator (2A12) and IF translator (2A3) for automatic gain control use.

### 4-10. MODE AND FREQUENCY SELECTION AND CONTROL LOOP.

4-11. Figure 4-4 is a diagram of the mode and frequency selection and control loop. The operating mode of the HF Radio Set is selected by the mode selector located on the radio set control frontpanel. Relays in IF translator 2A3 are energized by mode control information and provide the switching necessary for signal routing. The operating frequency is selected by four FREQ controls located on the radio set control. Frequency control information causes Autopositioner 2A12A1 to coarse tune VFO 2A12A2 and motor A12B1 to tune the 17.5-MHZ and HF oscillators. Frequency divider 2A1, KC frequency stabilizer 2A4, and MC frequency stabilizer 2A10 stabilize the oscillators by phase-locking the frequencies of the oscillators with frequencies derived from a highly stable 3-MHZ reference oscillator contained in RF oscillator 2A2. RF oscillator 2A2 also provides a 500-KHZ reference frequency of IF injection.

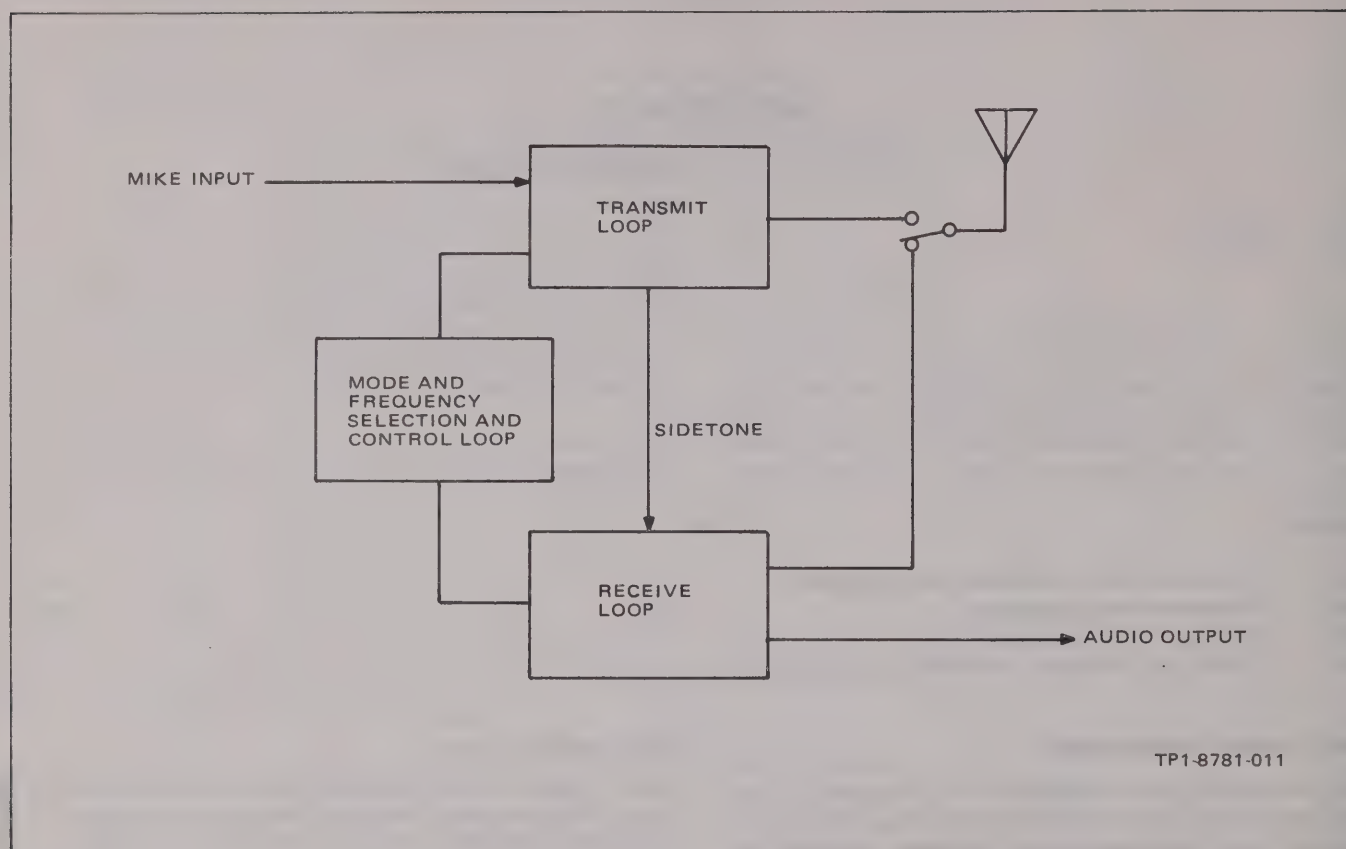


Figure 4-1. HF Radio Set, Functional Loop Diagram

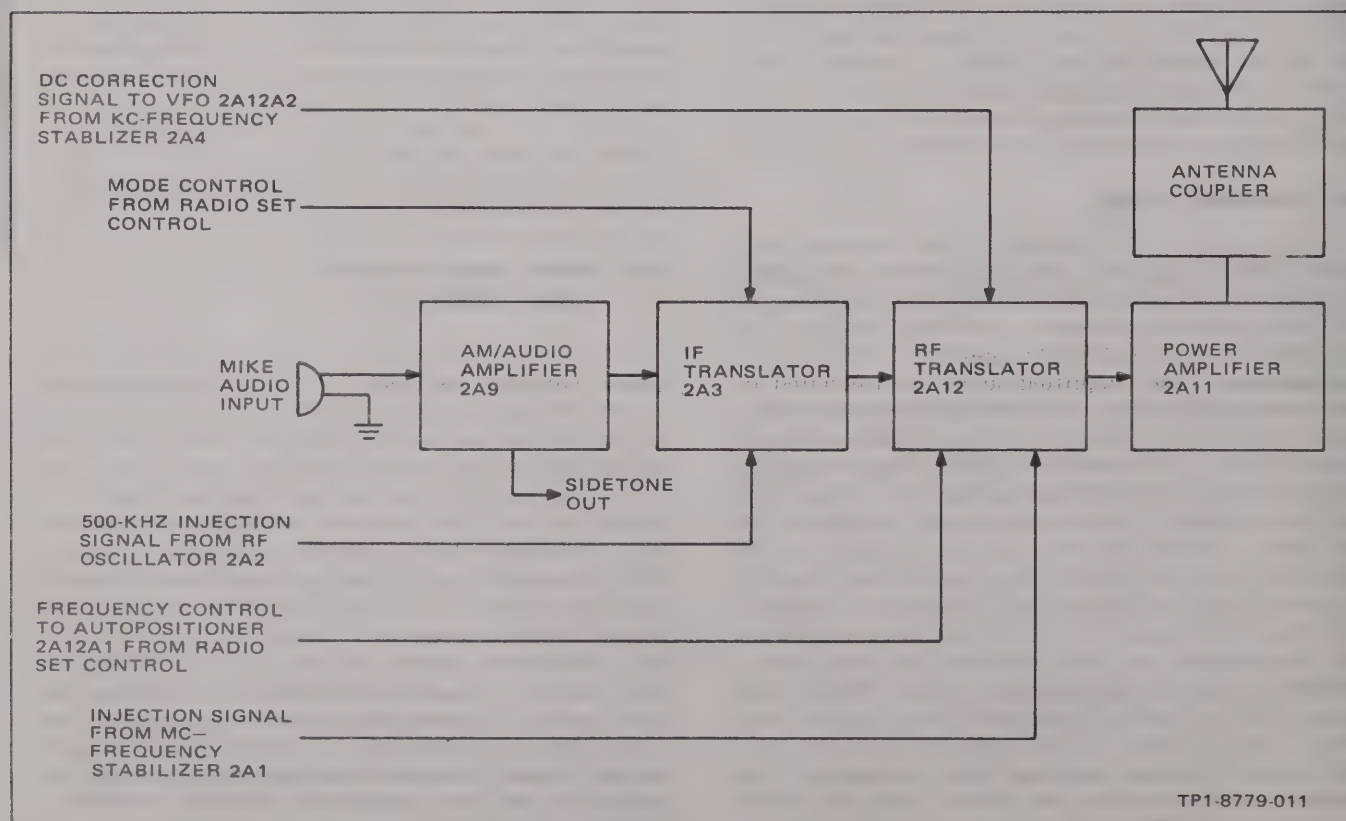


Figure 4-2. Transmit Loop Diagram

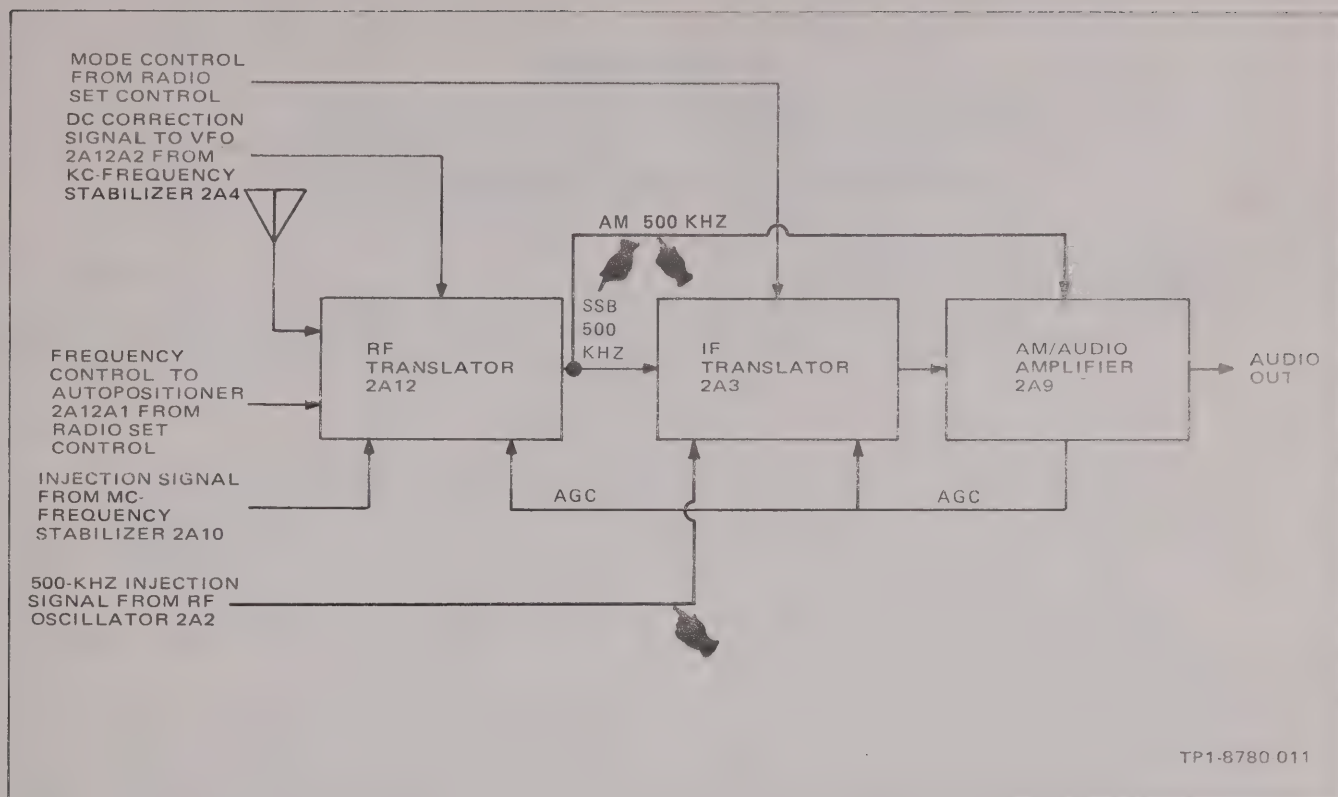


Figure 4-3. Receive Loop Diagram

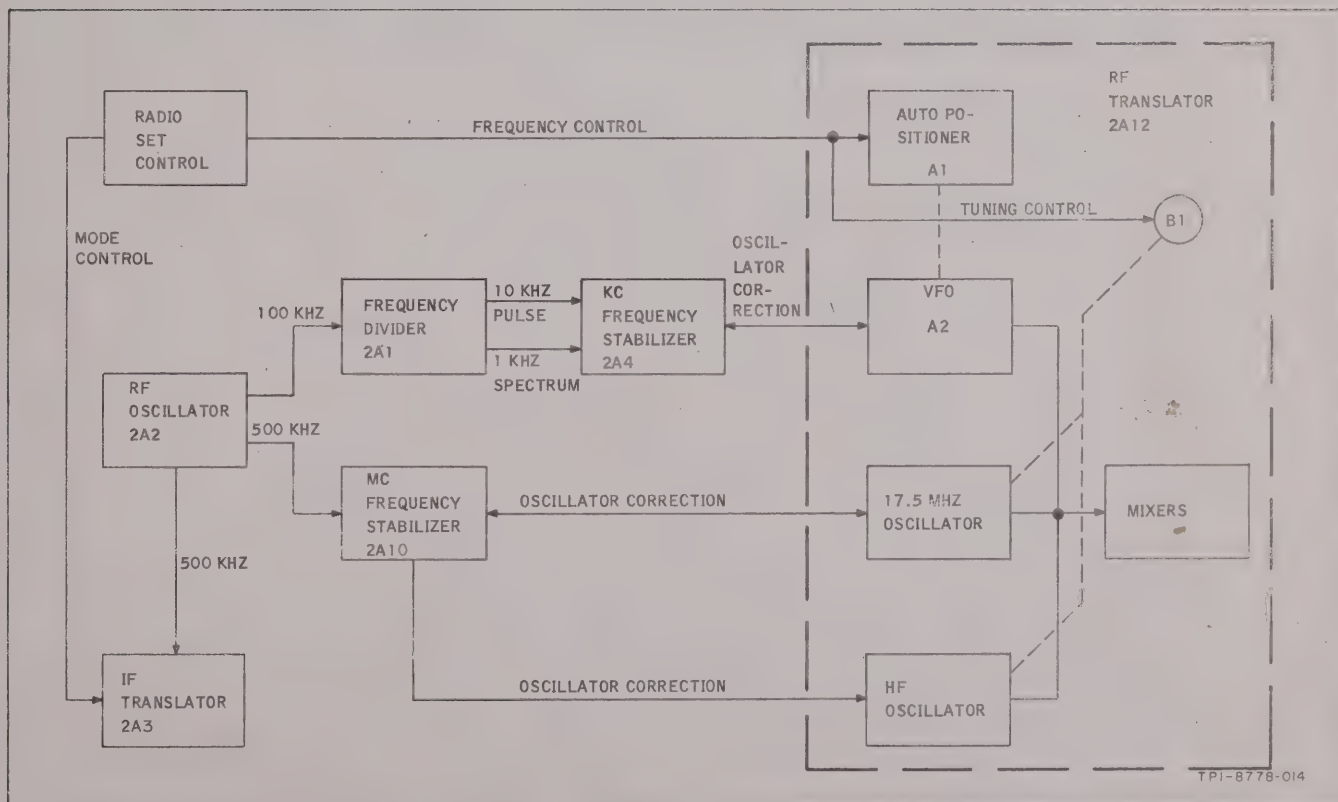


Figure 4-4. Mode and Frequency Selection and Control Loop Diagram



## SECTION V

### DESCRIPTION OF SYSTEM TIE-IN OF EQUIPMENT AND ACCESSORIES

#### 5-1. GENERAL.

5-2. This section contains information explaining the integration of the HF Radio Set into an operational HF communications system. Radio Set AN/ARC-105

is used as an example for explanation purposes; location of components and interconnection information is similar for all installations. The following illustrations are used in this section.

Figure	Title	Page
5-1	Radio Set AN/ARC-105, External Wiring Diagram . . . . .	5-3
5-2	Radio Set AN/ARC-105 and Antenna Coupler Group OF-17/ARC-105, External Wiring Diagram . . . . .	5-5
5-3	Radio Set AN/ARC-105 and Antenna Coupler Group ACG-101, External Wiring Diagram . . .	5-7

#### 5-3. COMPONENTS AND ACCESSORIES.

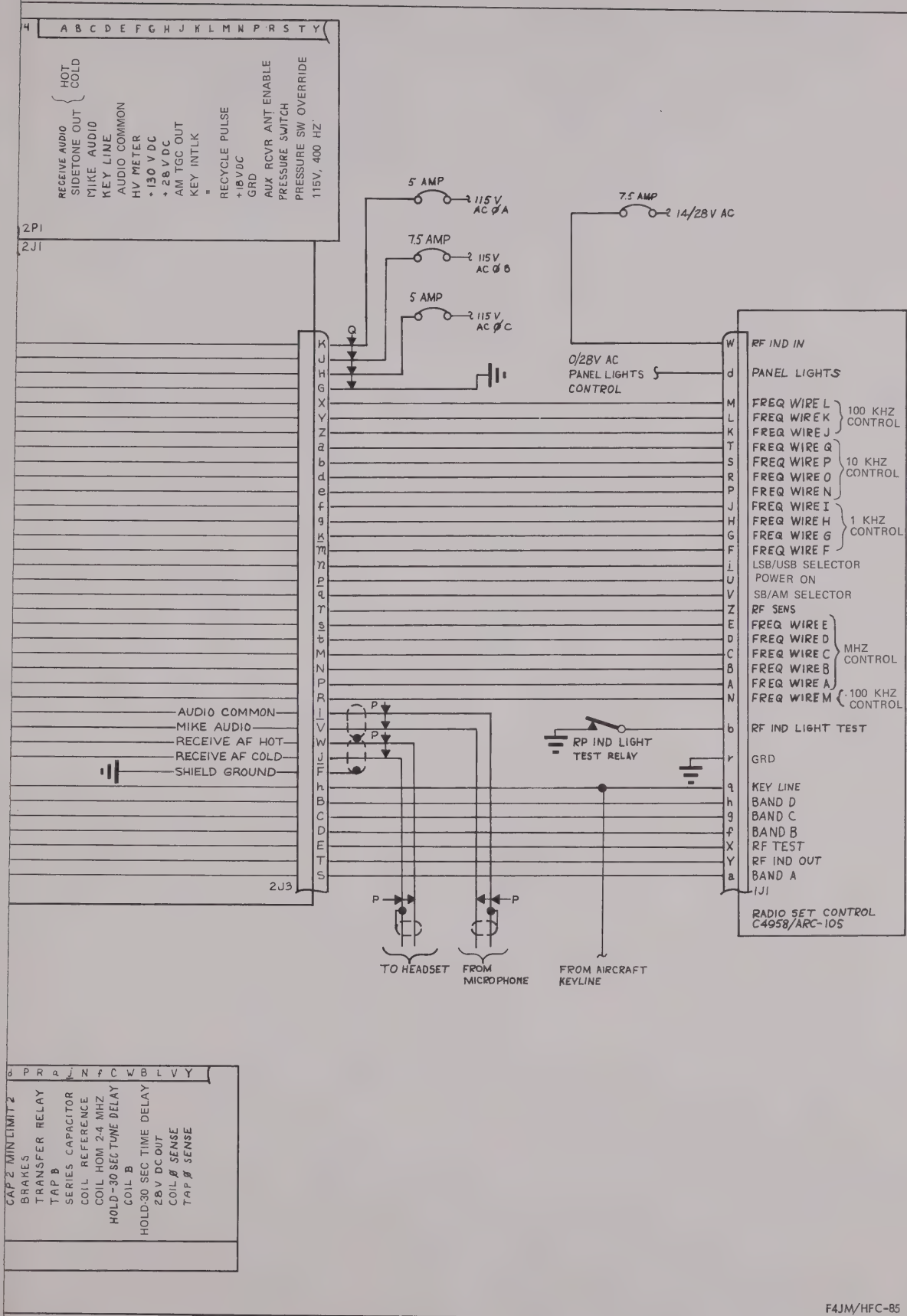
5-4. Radio Set AN/ARC-105 is made up of four major components: Radio Set Control C-4958/ARC-105, Radio Receiver-Transmitter RT-712/ARC-105, Antenna Coupler Control C-4959/ARC-105, C-8733/ARC-105 or 309C-1, and Antenna Coupler CU-1239/ARC-105, CU-1995/ARC-105 or 490R-1. The accessories provided are listed in figure 1-1 of this manual and in the antenna coupler system manuals (TO 12R2-2ARC105-2, NAVAIR 16-35OF17-1, and TO 12R2-4-1-102).

#### 5-5. INTEGRATION IN AN AIRCRAFT.

5-6. In a typical airborne installation, the radio receiver-transmitter and the antenna coupler control (including their associated mounts) are installed in the electronic compartment of the aircraft to take advantage of the shockmount installation facilities and cooling air available there. The radio set control is installed in the location most convenient to the operator, and the antenna coupler is mounted as close as practical to the antenna.

5-7. The above statements are general, and installation is determined by the installing agency.





F4JN/HFC-85

Figure 5-1. Radio Set AN/ARC-105, External Wiring Diagram





5-3/5-4









Figure 5-2. Radio Set AN/ARC-105 and Antenna Coupler Group OF-17/ARC-105, External Wiring Diagram



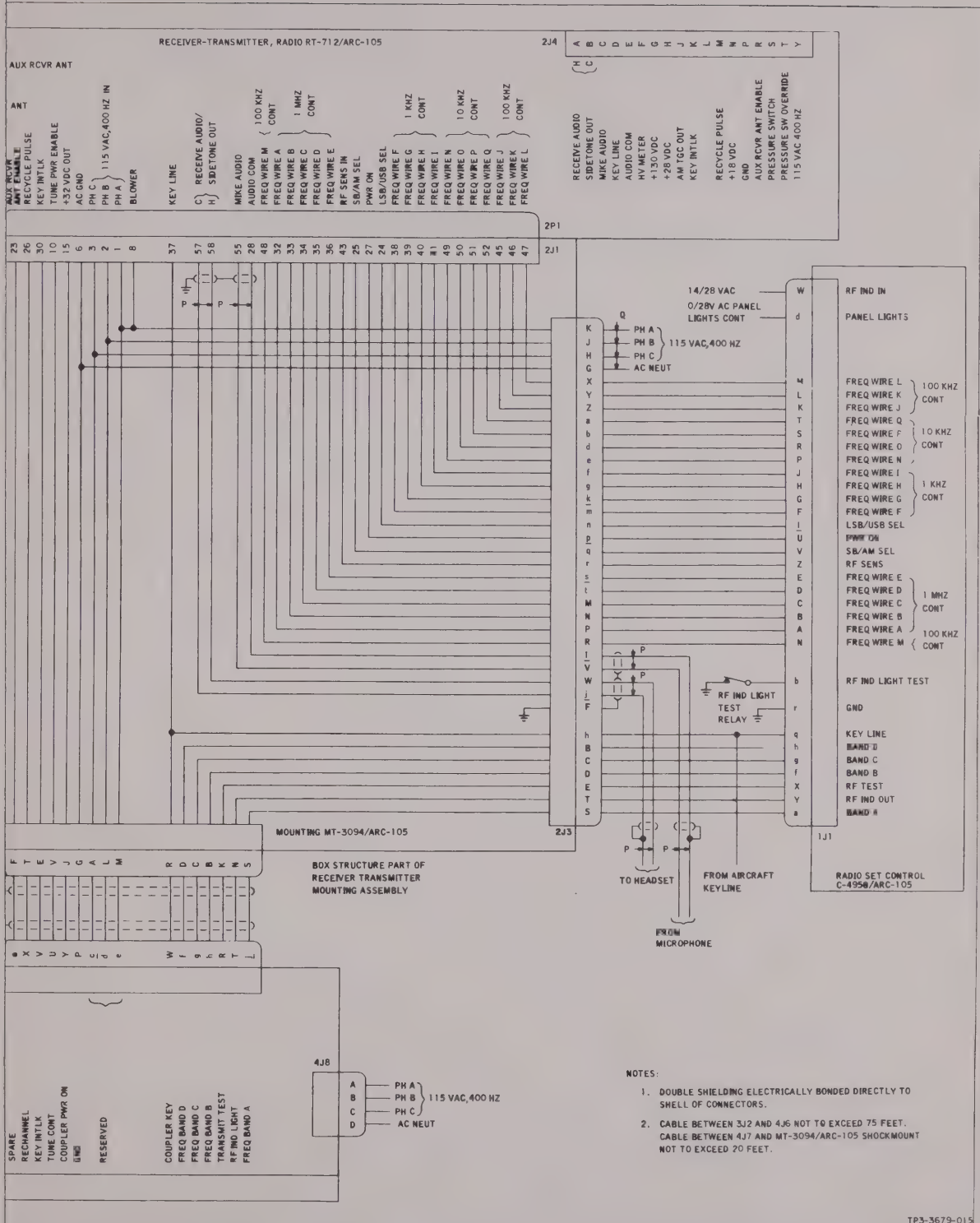


Figure 5-3. Radio Set AN/ARC-105 and Antenna Coupler Group ACG-101, External Wiring Diagram





Change 3 5-7/5-8



## SECTION VI

# CHECKOUT AND ANALYSIS

### 6-1. GENERAL.

6-2. This section contains detailed theory of operation and minimum performance test procedures for

the HF Radio Set. Checkout, analysis, maintenance, and overhaul instructions for the units that comprise the HF Radio Set are contained in sections VII through X. The illustrations and tables contained in this section are as follows:

Figure	Title	Page
6-1	Standard Military Electronic Symbols . . . . .	6-2
6-2	Nonstandard Military Electronic Symbols . . . . .	6-4
6-3	HF Radio Set, Detailed Block Diagram . . . . .	6-5
6-4	Test Equipment Hookup, Transmitter Checks . . . . .	6-8
6-5	Test Equipment Hookup, Receiver Checks . . . . .	6-9
6-6	Test Equipment Hookup, Modulation Capability Checks . . . . .	6-10
6-7	Test Equipment Hookup, Sidetone Operation and Tune Power Checks . . . . .	6-11
6-8	Initial Control Settings. . . . .	6-11
6-9	Minimum Performance Test Procedures . . . . .	6-12

### 6-3. SYMBOL CHARTS.

6-4. Figures 6-1 and 6-2 are tables that explain the graphic symbols used in the illustrations in this manual. Figure 6-1 illustrates the standard military electronic component symbols. Figure 6-2 illustrates the nonstandard electronic component symbols.

### 6-5. THEORY OF OPERATION.

6-6. TRANSMIT MODE. (Refer to figure 6-3.)

6-7. AM/audio amplifier 2A9 provides two stages of audio amplification for the voice signal and also provides an output to the headset (sidetone) that allows the operator to monitor his transmission. During tuning, AM/audio amplifier 2A9 applies a 1-KHZ tune tone to the headset.

6-8. The transmit path continues from AM/audio amplifier 2A9 to balanced modulator 2A3CR1. There the audio is combined with a 500-KHZ carrier generated by RF oscillator 2A2. Balanced modulator 2A3CR1 produces intelligence as sidebands of the 500-MHZ carrier and then suppresses the carrier. The double-sideband signal appears at the output of balanced modulator 2A3CR1 and is amplified by ALC (automatic load control) amplifier 2A3Q1.

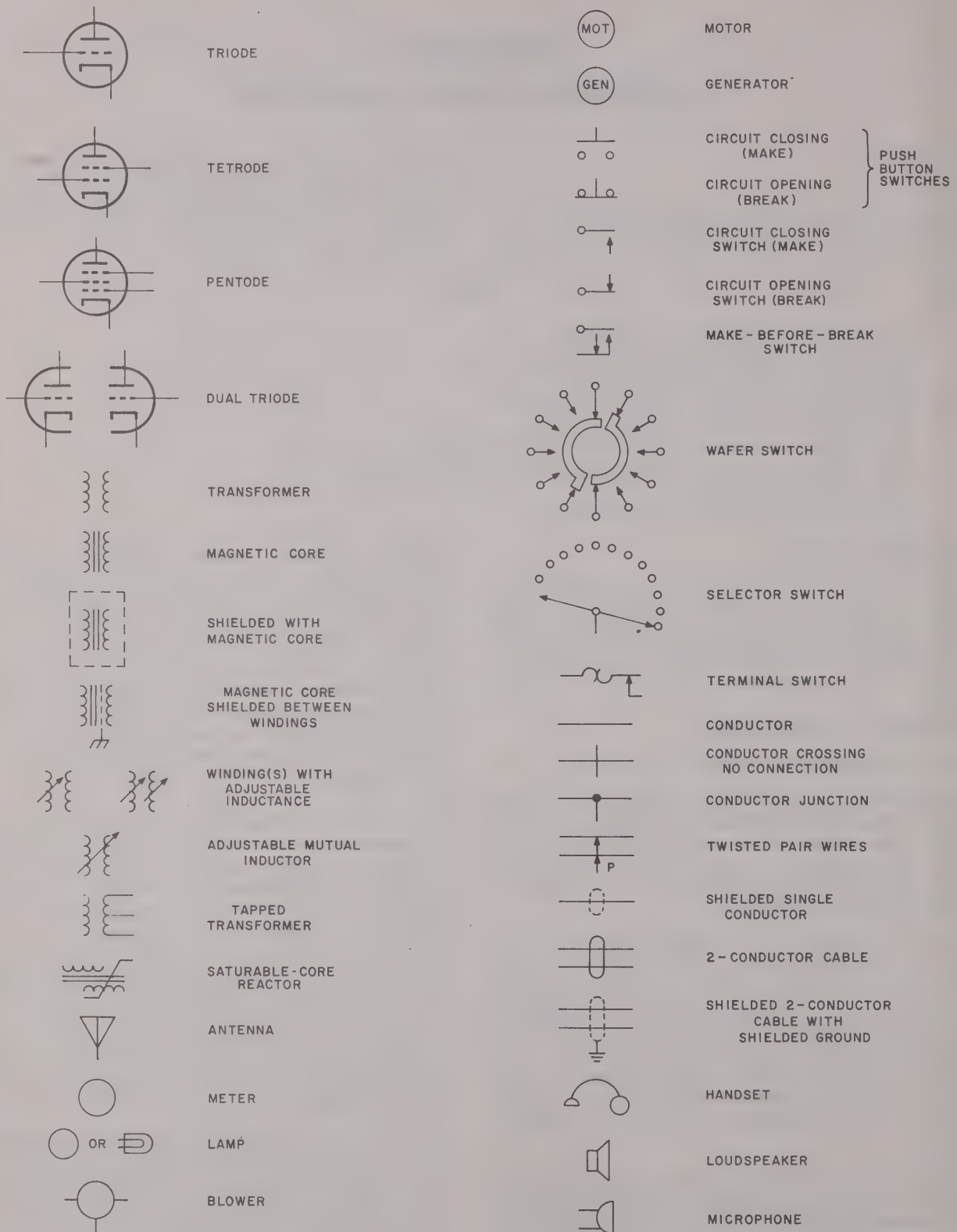
6-9. The voice signal may overdrive power amplifier 2A11 if the operator speaks too loudly or during voice peaks. Feedback from the grid circuit of power amplifier 2A11 is generated if the driving signal causes power amplifier grid current to flow. The feedback voltage, in turn, reduces the gain of ALC amplifier 2A3Q1. In this manner, drive to power amplifier 2A11 is held at an optimum value near grid current threshold.

6-10. The transmit signal continues from ALC amplifier 2A3Q1 through IF amplifier 2A3Q2 and is then fed to one of two mechanical filters 2A3FL1 or 2A3FL2. Either 2A3FL1 or 2A3FL2 is selected by the mode selector switch (in USB or LSB position) on the radio set control. Only one sideband is needed since both contain identical intelligence. The bandpass of 2A3FL1 and 2A3FL2 is 3 KHZ (nominal). Beyond the selected filter, the signal is a suppressed carrier containing one set of sidebands that represent the voice modulation.

6-11. Since the suppression of the carrier prevents a conventional AM receiver from detecting the SSB signal, the carrier must be reinserted for compatibility with conventional AM receivers. This happens when the function selector switch on the radio set control is switched to the AM position. In the AM mode of operation, the USB filter is also selected. Note that the transmit signal from the mechanical filter goes directly to IF amplifier 2A3Q4, bypassing IF amplifier 2A3Q3. IF amplifier 2A3Q4 is controlled by TGC/ADC (transmit gain control/automatic drive control) amplifier 2A3Q6, a DC amplifier that operates to reduce the gain of IF amplifier 2A3Q4.

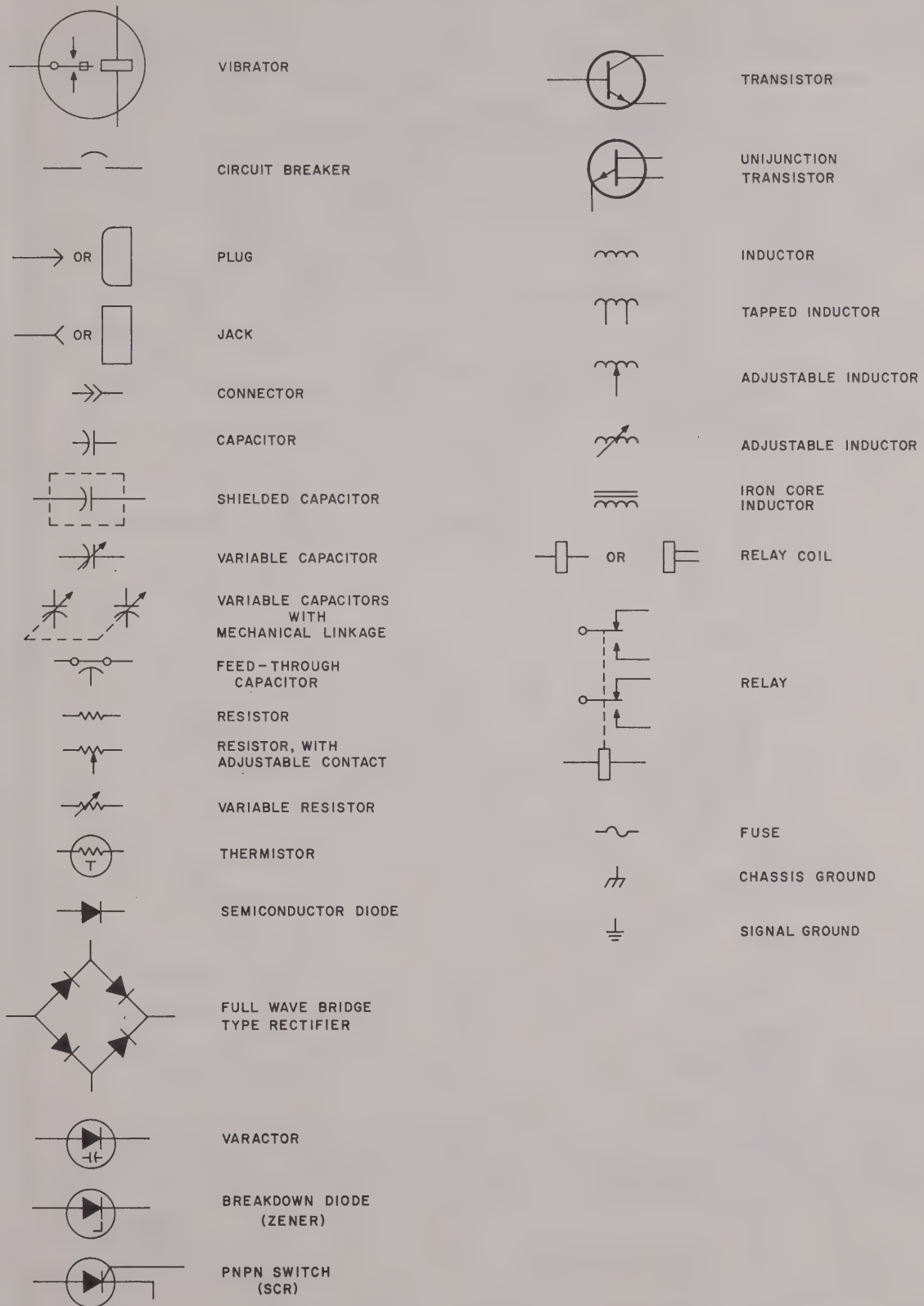
6-12. In the AM mode, the TGC circuit maintains the RF carrier level constant within 1 DB to compensate for varying RF gain over the operating range of the HF Radio Set for TGC reference. The feedback voltage applied to TGC/ADC amplifier 2A3Q6 is a rectified sample of the carrier obtained from a linear demodulator and is proportional to the average instantaneous peak carrier amplitude.

6-13. The ADC circuit provides override or additional control of IF amplifier 2A3Q4 during the tuning cycle



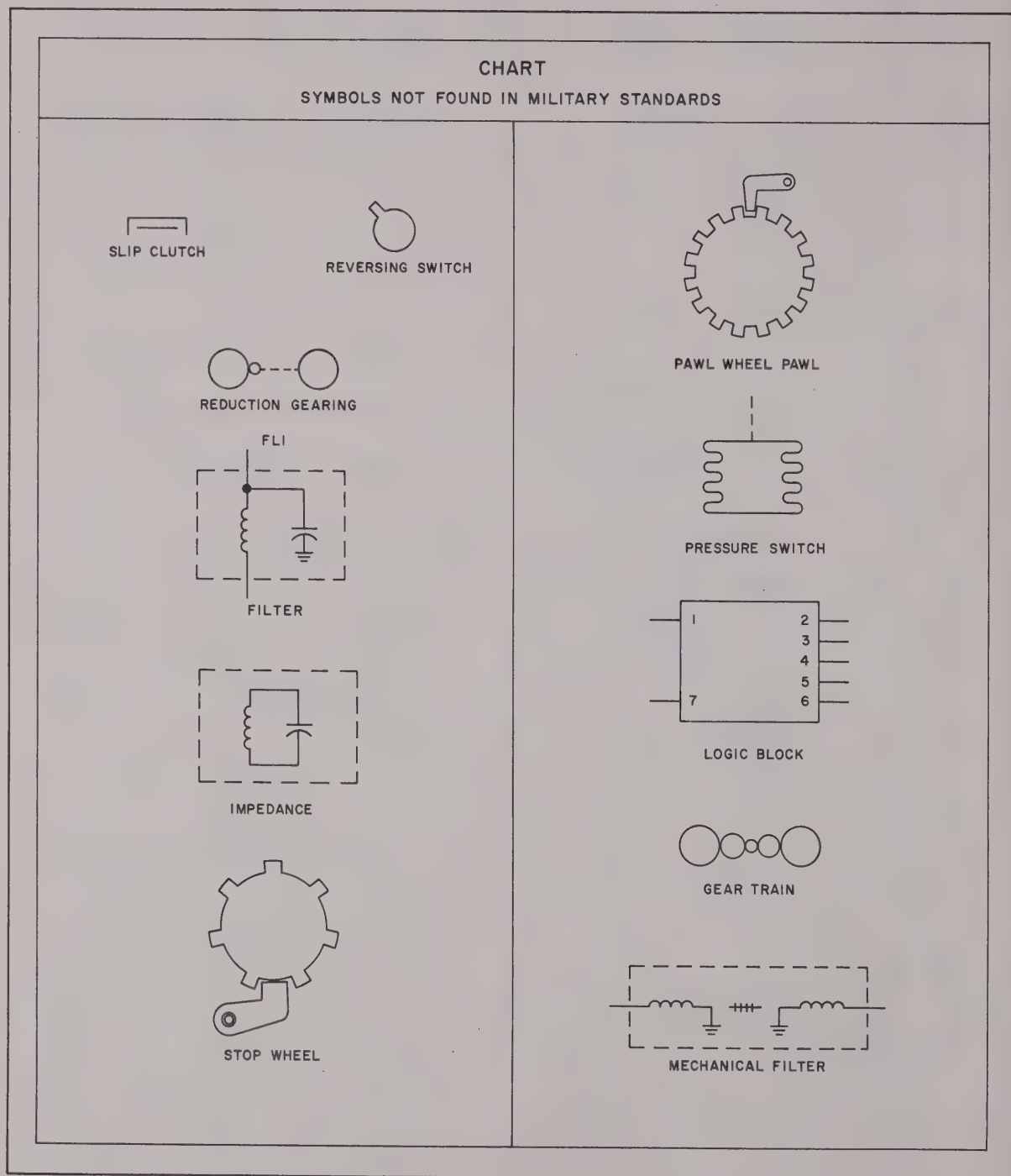
TPI-9360-024

Figure 6-1. Standard Military Electronic Symbols (Sheet 1 of 2)



TPI-9360-024

Figure 6-1. Standard Military Electronic Symbols (Sheet 2 of 2)



TPI-9361-014

Figure 6-2. Nonstandard Military Electronic Symbols

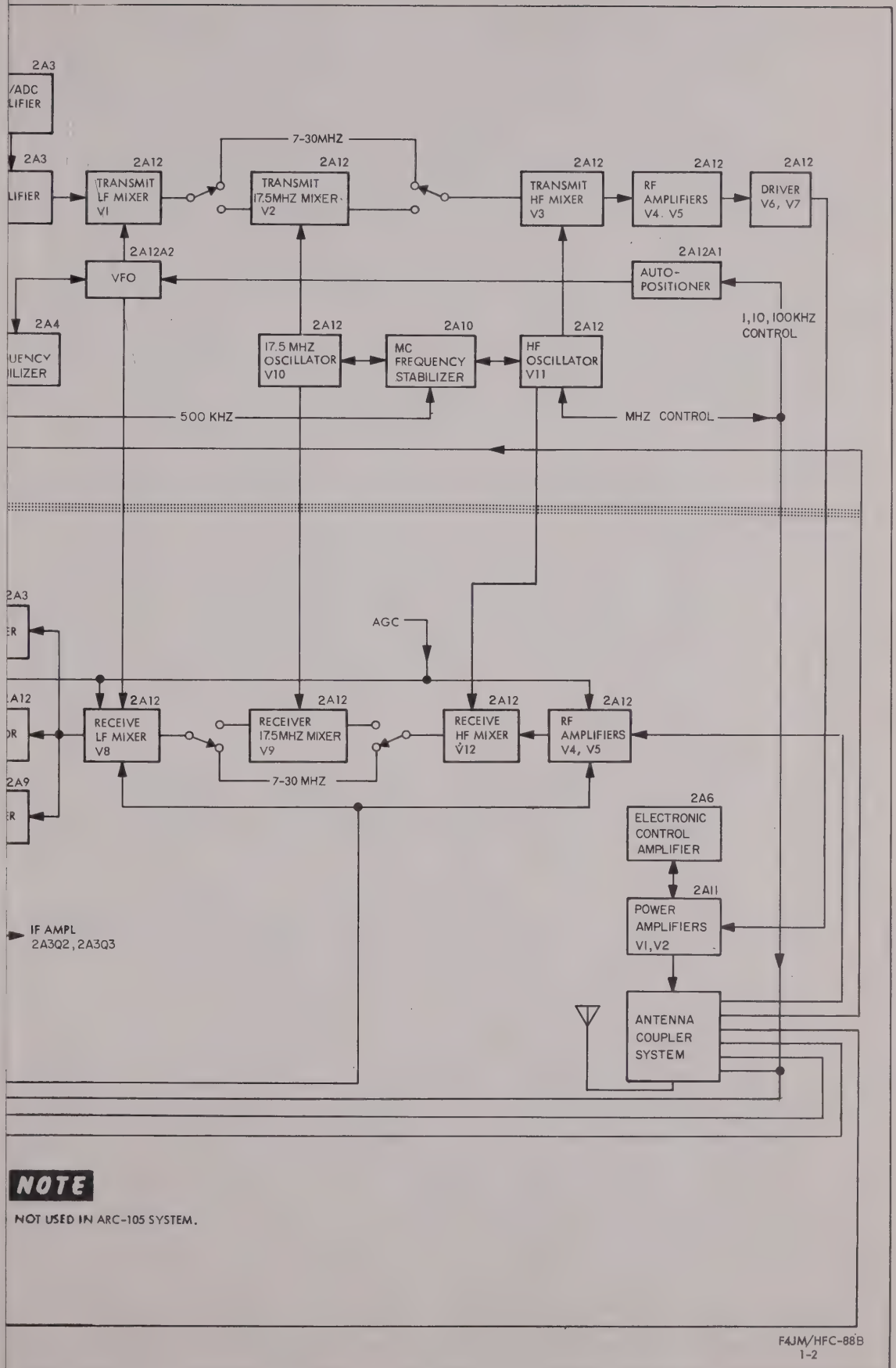



Figure 6-3. HF Radio Set, Detailed Block Diagram

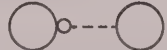
CHART  
SYMBOLS NOT FOUND IN MILITARY STANDARDS



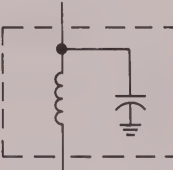
SLIP CLUTCH



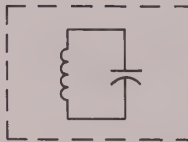
REVERSING SWITCH




REDUCTION GEARING



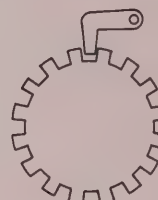
FLI  
FILTER



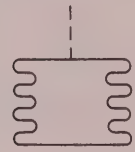
IMPEDANCE



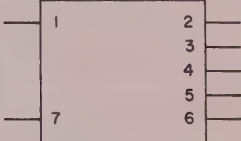
STOP WHEEL



PAWL WHEEL PAWL



PRESSURE SWITCH



LOGIC BLOCK



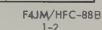
GEAR TRAIN



MECHANICAL FILTER

TPI-9361-014

Figure 6-2. Nonstandard Military Electronic Symbols



6-5

or if a malfunction occurs resulting in excessive RF plate voltage or plate current swing. The feedback voltages applied to the ADC and TGC circuits combine so that linear operation is maintained for power amplifier 2A11 during changes in RF gain and RF drive. The transmit signal, after amplification by IF amplifier 2A3Q4, is applied to transmit LF (low-frequency) mixer 2A12V1.

6-14. The transmit signal from the IF translator is combined in LF mixer 2A12V1 with the output of VFO 2A12A2. For any of the operating frequencies, the output of LF mixer 2A12V1 will be 3.000 to 2.001 MHZ. The transmit signal goes from transmit LF mixer 2A12V1 to one of two paths. If the operating frequency is below 7 MHZ, the transmit signal is mixed in transmit 17.5-MHZ mixer 2A12V2 and applied to transmit HF mixer 2A12V3. If the operating frequency is above 7 MHZ, the transmit signal goes from transmit LF mixer 2A12V1 directly to HF transmit mixer 2A12V3, bypassing the 17.5-MHZ mixer. The output of 17.5-MHZ mixer 2A12V2 is the difference output between the transmit signal and 17.5-MHZ oscillator 2A12V10. The output of transmit 17.5 MHZ mixer is applied to HF transmit mixer 2A12V3. The output of this mixer is the difference signal from 2 through 29.999 MHZ. HF oscillator 2A12V11 operates below the transmit signal from 2 through 6 MHZ and above the transmit signal from 7 through 29.999 MHZ. The HF oscillator also doubles frequencies to provide heterodyning for operating frequencies of 14 through 29.999 MHZ. The output of HF transmit mixer 2A12V3 is the transmit signal at the operating frequency. Transmit mixers 2A12V1, 2A12V2, and 2A12V3 provide linear amplification and are balanced mixers; that is, the oscillator signal for each mixer is simultaneously applied to one triode element for mixing and to the other element 180 degrees out of phase for cancellation (balancing out) of the oscillator output in the signal path. Extra circuits are provided in HF transmit mixer 2A12V3 to provide cancellation through a nulling adjustment. The balanced mixers help reduce spurious signals that can distort the signal and/or radiate interference at unwanted frequencies. After the HF mixing, the transmit signal is amplified by linear voltage amplifiers in two stages; RF amplifier 2A12V4 and 2A12V5 and driver amplifier 2A12V6 and 2A12V7. The driver stages provide sufficient RF voltage to drive power amplifier 2A11.

6-15. The power amplifier consists of two parallel connected tetrodes driving a PI network that combines the functions of tank circuit loading of the tubes and impedance matching to low-impedance unbalanced transmission lines. The power amplifier develops approximately 125 watts carrier power in the AM mode and 400 watts PEP in the single-sideband modes. The output of power amplifier 2A11 is coupled to an antenna coupler so that a variety of antennas may be driven with minimum VSWR.

6-16. Grid current flow is detected in this module and fed back as controlling bias voltage to the ALC amplifier in the IF translator module to control transmit IF gain. A sample of RF voltage is taken from the plate circuit, rectified, and applied as negative DC voltage to the TGC/ADC amplifier in IF translator 2A3 for additional IF gain control.

6-17. Coarse tuning and antenna loading are performed by a motor that is actuated through band switching in RF translator 2A12. Fine tuning to resonance requires that the radio receiver-transmitter be keyed after frequency selection. Since a carrier must be present, internal switching selects the AM mode for this operation. Resonance is achieved by discriminating between the RF input and output phase and applying the detected difference as an error voltage to electronic control amplifier 2A6. Electronic control amplifier 2A6 inverts the error signal (a DC voltage) to 400 HZ and amplifies it sufficiently to drive the servo motor. The servo motor drives a roller coil to tune the tank circuit.

6-18. RECEIVE MODE. (Refer to figure 6-3.)

6-19. In the receive mode, the incoming RF signal is coupled directly from the antenna to RF amplifiers 2A12V4 and 2A12V5. The antenna coupler is effectively bypassed. Conversion of the RF signal in translator 2A12 in the receive mode is similar to the transmit mode except that separate unbalanced mixer circuits are used. The signal level is adjusted manually by varying the RF sensitivity control on the radio set control. The RF sensitivity control controls the cathode bias of RF amplifiers 2A12V4 and 2A12V5 and thereby varies the signal-to-noise ratio. The RF sensitivity control is not an audio level control.

6-20. The received signal continues through RF translator 2A12 to receive LF mixer 2A12V8. The output of LF mixer 2A12V8 is applied directly to IF amplifier 2A3Q2 and to IF amplifier 2A9Q3. This allows detection of received signals in both single-sideband and AM modes.

6-21. Assume that the received signal is single-sideband. The output of LF mixer 2A12V8 is amplified by IF amplifier 2A3Q2 and then passed through mechanical filter 2A3FL1 or 2A3FL2, as selected at the radio set control. The signal from the mechanical filter is amplified by IF amplifiers 2A3Q3, 2A3Q4, and 2A3Q5. AGC detector 2A12CR6 is reverse biased to prevent entry of receive signals into RF translator 2A12. From IF amplifier 2A3Q5, the signal goes to the product detector where it is combined with a 500-KHZ carrier from RF oscillator 2A2. The output of the product detector, the detected audio, is applied through audio amplifiers 2A9Q8, 2A9Q1, and 2A9Q2 to the headset.

6-22. A number of AGC feedback loops are used in the radio receiver-transmitter. The single-sideband

AGC is developed from the audio signal. AGC is first applied to RF amplifiers 2A12V4 and 2A12V5. Two sources, other than manual RF sensitivity, combine to control this stage. A very strong signal causes the AGC circuit in the plate circuit of receive LF mixer 2A12V8 to reduce the gain of both the LF mixer and the RF amplifier. A normal signal level is controlled by AGC from detector 2A9CR2 and 2A9CR13. The AGC voltage is proportional to the RMS audio output voltage from 2A9Q2.

#### 6-23. FREQUENCY GENERATION AND STABILIZATION.

6-24. The HF Radio Set transmits and receives on 28,000 discrete channels spaced 1 KHZ apart in the HF band (2.000 to 29.000 MHZ). Frequency and mode of operation (single-sideband or AM) is selected at the radio set control. The 100-, 10-, and 1-KHZ frequency selector switches on the radio set control provide control information in the form of grounded or open circuits to Autopositioner 2A12A1. The Autopositioner mechanically tunes VFO 2A12A2 over the range of 2.501 to 3.500 MHZ in 1000 one-KHZ increments. A motor in RF translator 2A12 is controlled by frequency information provided by the MHZ frequency selector switch on the radio set control. This motor switches tuning elements which tune HF oscillator 2A12V11 to 28 frequencies, each 1 MHZ apart. The HF oscillator, in conjunction with 17.5-MHZ oscillator 2A12V10, provides 28 one-MHZ bands for each of the 1000 one-KHZ increments from the VFO.

6-25. MC frequency stabilizer 2A10 stabilizes the frequency of the 17.5-MHZ and HF oscillators by comparing each oscillator frequency with the frequency of a spectrum point derived from the 500-KHZ output of RF oscillator 2A2. The coarse frequency of 2A12V11 is controlled by the MHZ band switches in RF translator 2A12. The frequency range of 2A12V11 is 8.5 to 16.0 MHZ. The MHZ band switches tune the output of 2A12V11 to the second harmonic of the fundamental oscillator frequency when the selected operating frequency is in the range of 14.0 to 29.999 MHZ. This signal is coupled to transmit HF mixer 2A12V3, and to receive HF mixer 2A12V12.

6-26. The high stability of the HF Radio Set is obtained by basing frequency control of the entire radio receiver-transmitter on the frequency of a crystal oscillator located in RF oscillator 2A2. Frequency stability of this crystal oscillator is 0.8 part per million and is assured by utilizing a temperature compensating network. The HF and 17.5-MHZ oscillators are frequency locked, and the VFO is phase locked to the crystal generated reference frequency by circuits in the MC- and KC-frequency stabilizer modules. The IF injection frequency is also derived from the crystal oscillator frequency.

#### 6-27. MINIMUM PERFORMANCE TEST PROCEDURES

##### 6-28. TEST SETUP.

6-29. Before interconnecting equipment ensure that all primary power switches are placed in OFF position.

#### WARNING

Before connecting the primary power cable to the bench, make sure that a ground strap is connected between the ground lug on the bench and the nearest ground point of the primary power source.

Perform the preparation for maintenance procedures of paragraph 2-3. Test equipment setup information is contained in figures 6-4 through 6-7; references to the applicable figure are contained in the test procedure. All test equipment required is listed in figure 3-1.

#### NOTE

Equivalent test equipment may be substituted. The cable reference designators used in sections VI and VIII are not applicable when Radio Set Test Set AN/ARM-158 is used to test Radio Set AN/ARC-105.

#### 6-30. INITIAL CONTROL SETTINGS.

6-31. Refer to figure 6-8. Deviations from the initial control settings are covered in the test procedures.

##### 6-32. MINIMUM PERFORMANCE TEST PROCEDURES.

6-33. Proper use of the minimum performance test procedures (refer to figure 6-9) will enable the test operator to isolate a malfunction of the radio receiver-transmitter to a faulty module. Equipment being returned to service should be tested using these procedures to verify that it is operating properly.

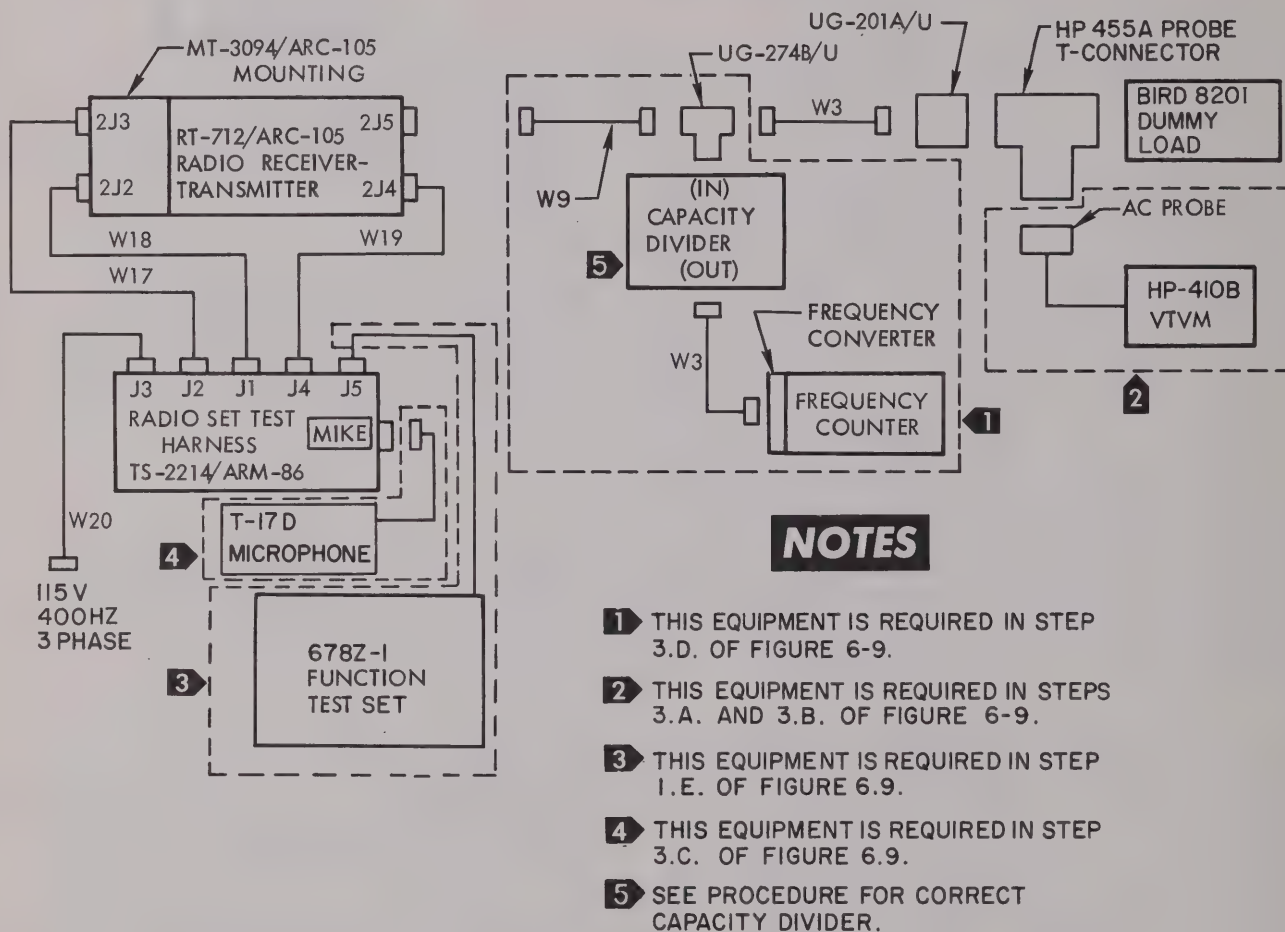
6-34. The procedures should be performed in the order given. If a malfunction is noted, the applicable module test procedure, section VIII, should be performed.

#### NOTE

Performance test procedures for Radio Set Control C-4958/ARC-105 are contained in section VII of this manual.

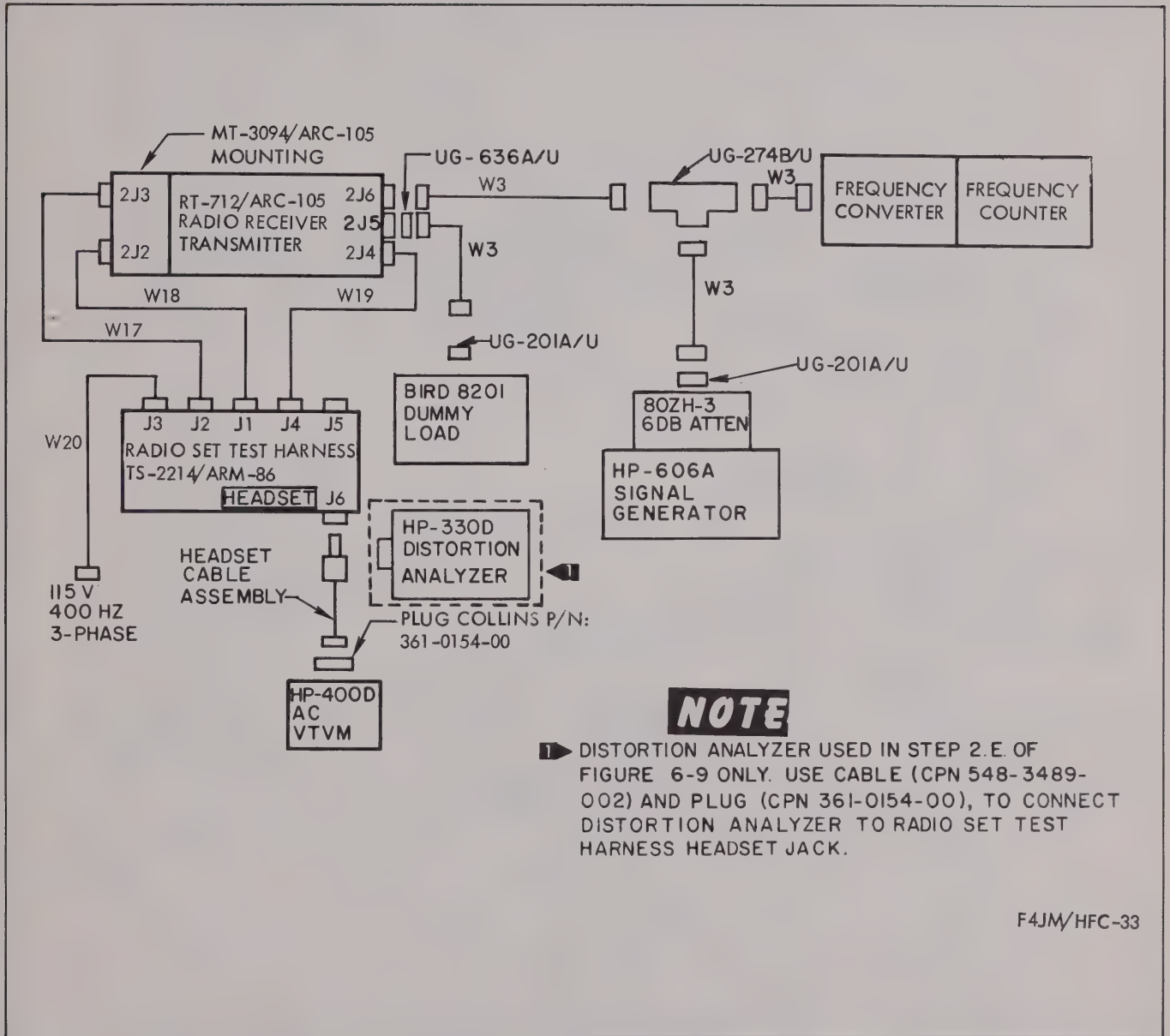
#### 6-35. TROUBLE ANALYSIS.

6-36. Trouble analysis information is incorporated in any PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY column of figure 6-9.



F4JM/HFC-35

Figure 6-4. Test Equipment Hookup, Transmitter Checks



F4JM/HFC-33

Figure 6-5. Test Equipment Hookup, Receiver Checks

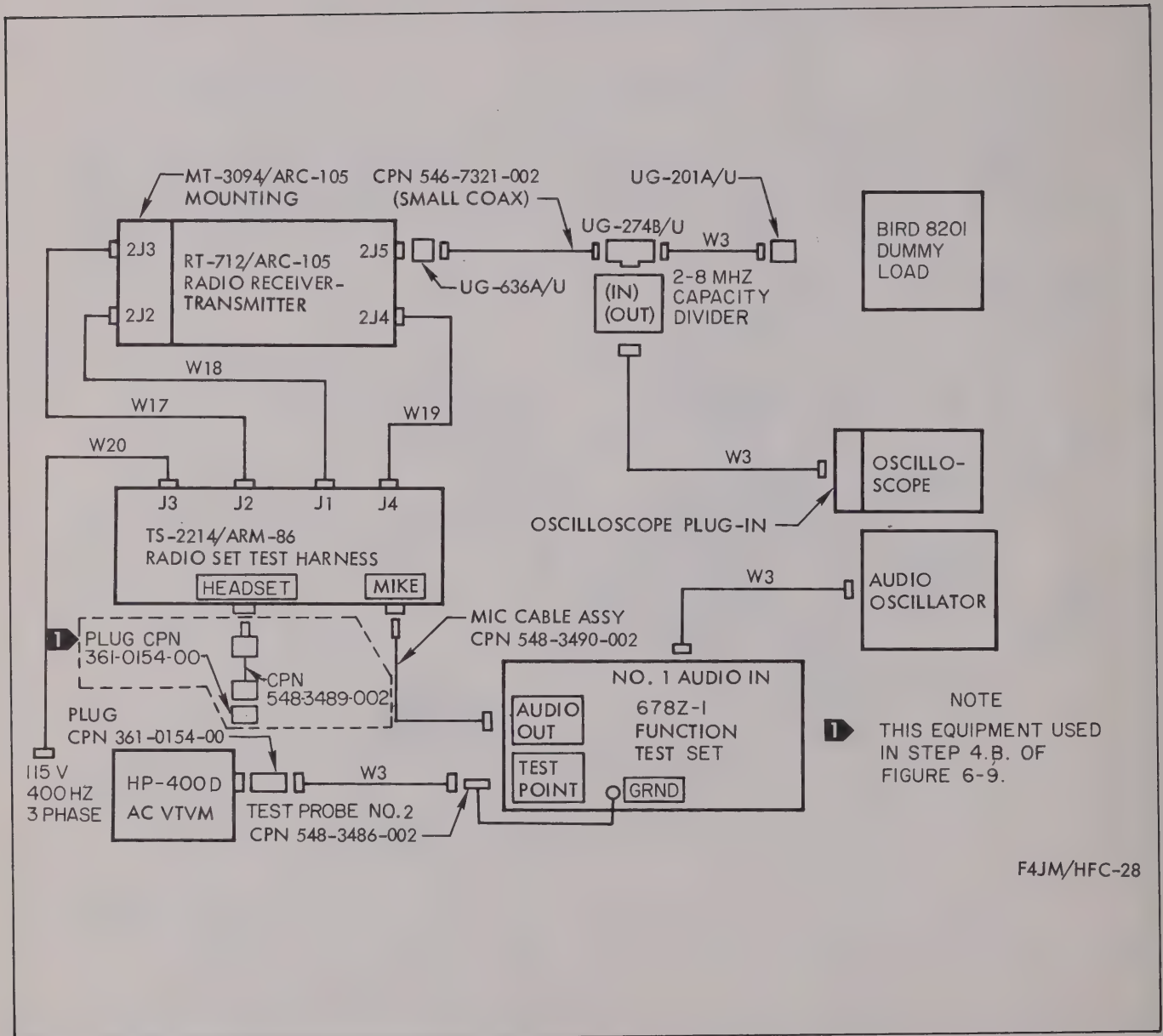


Figure 6-6. Test Equipment Hookup, Modulation Capability Checks

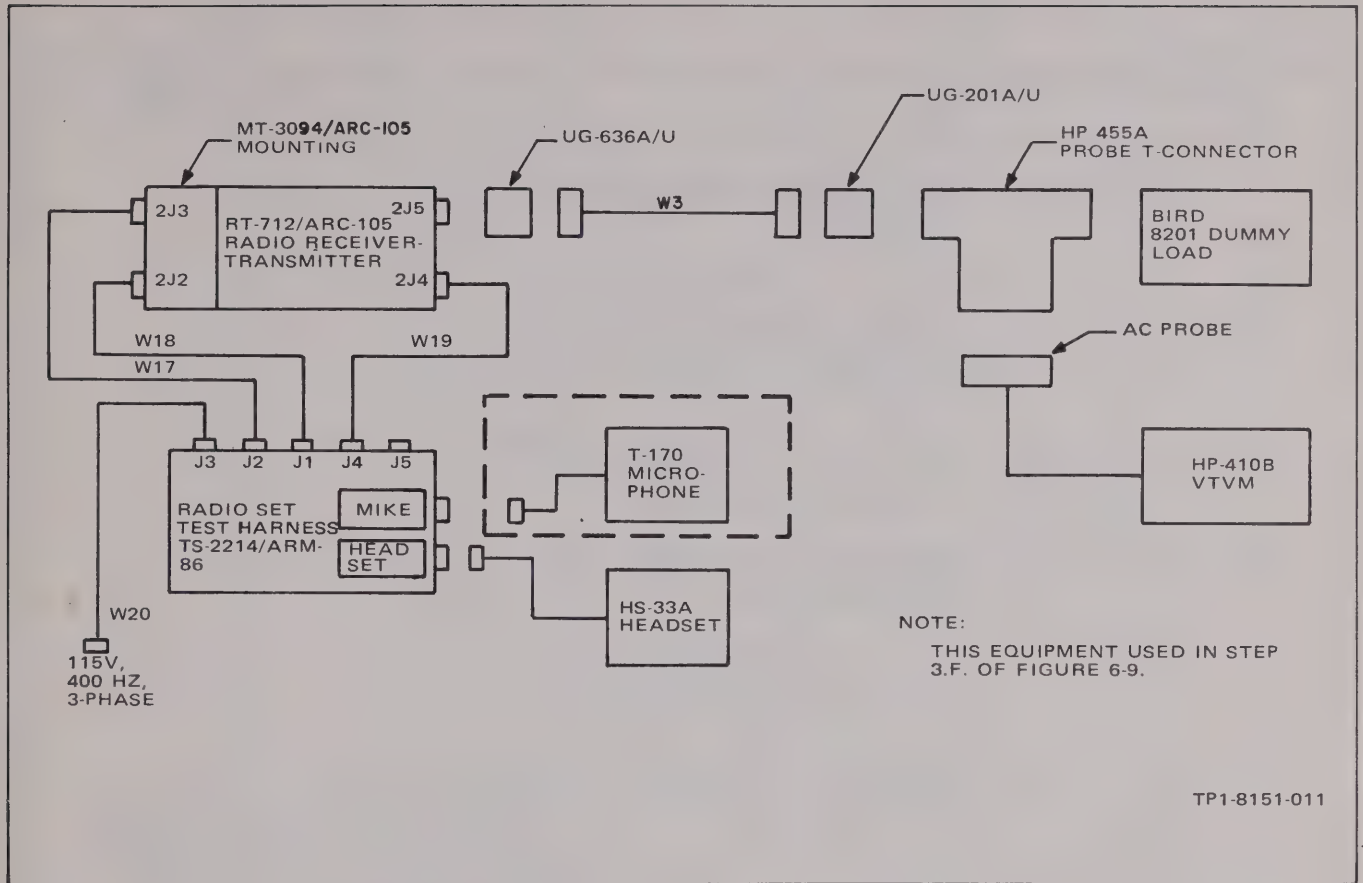


Figure 6-7. Test Equipment Hookup, Sidetone Operation and Tune Power Checks

UNIT OR COMPONENT	CONTROL	POSITION
Radio Set Test Harness TS-2214/ARM-86	POWER PRESSURE SWITCH LAMP TEST TUNE POWER 300 OHM AUDIO LOAD AUX RCVR KEY INTLK KEY R/T TEST SWITCH	OFF BYPASS OFF OFF NORMAL IN BYPASS OFF 28V
Radio Set Control C-4958/ARC-105	Mode selector	OFF
HD-544 and HVU blowers	Power cables	Disconnected

Figure 6-8. Initial Control Settings

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
1		Preliminary tests	Interconnect radio receiver-transmitter and test equipment as shown in figure 6-4.  NOTE  If this test is being used as a preflight inspection, the cover should remain on. If not, depressurize unit, and remove cover.		
1A		Power supply and power amplifier plate current check.	<p>Apply 115-volt, 400-HZ, 3-phase primary power to radio set test harness input power cable W20.</p> <p>Apply 115-volt, 60-HZ, single-phase primary power to HVU blower power cable.</p> <p>Set 115-volt, 400-CPS and 115-volt, 60-CPS circuit breakers (located at rear of work area on bench) to ON position. Set radio set control mode selector to USB.</p> <p>Position radio set test harness POWER switch to ON.</p> <p>Set 678Z-1 ON-OFF switch to ON position.</p> <p>NOTE</p> <p>Allow 15 minutes for equipment to warm up.</p> <p>Position R/T TEST SWITCH on radio set test harness to 28V and 130V in turn. Position R/T TEST SWITCH on radio set test harness to 1500 V.</p> <p><b>CAUTION</b></p> <p>Do not exceed 5-minute transmit/receive duty cycle.</p>	<p>Radio set test harness POWER lamp should light and radio receiver-transmitter blower should operate.</p> <p><b>CAUTION</b></p> <p>Position POWER switch to OFF immediately if blower does not operate.</p> <p>R/T TEST METER should indicate 5 <math>\pm</math>1 meter increments.</p>	<p>Repair or replace faulty POWER lamp and/or blower.</p> <p>NOTE</p> <p>Refer to Radio Set Test Bench AN/ARM-86 (TO 33D7-4-14-1) for repair procedures of faulty equipment contained in AN/ARM-86.</p> <p>Check primary power 3-phase input.</p> <p>Replace power supply 2A7 and recheck.</p>
(Cont)					

Figure 6-9. Minimum Performance Test Procedures (Sheet 1 of 11)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
1A (Cont)			<p>Position KEY switch on radio set test harness to ON, note reading, and unkey.</p> <p>Position R/T TEST SWITCH on radio set test harness to PA MA.</p> <p>Position KEY switch on radio set test harness to ON, note reading, and unkey.</p> <p>Using a nonmetallic tool, depress switch 2A11S4, and key radio receiver-transmitter (in that order).</p> <p>Note R/T TEST METER reading, and unkey before releasing switch 2A11S4.</p> <p>Using a nonmetallic tool, depress switch 2A11S5, and key radio receiver-transmitter (in that order).</p> <p>Note R/T TEST METER reading, and unkey before releasing switch 2A11S5.</p>	<p>R/T TEST METER should indicate 5 <math>\pm</math>1.0 meter increments.</p> <p>R/T METER should indicate between 2.5 and 3.0 meter increments.</p> <p>R/T TEST METER should decrease between 0.7 and 1.2 meter increments.</p> <p>Previous meter reading <math>\pm</math>0.2 meter increment.</p>	<p>Same as above.</p> <p>Perform step 2 of figure 8-57.</p> <p>Replace power amplifier 2A11, and recheck.</p> <p>Replace power amplifier 2A11.</p> <p>Same as above.</p>
1B	2A7J2 (F2)	+18.0-volt DC check	<p>Connect MIL-V-9999 differential voltmeter between test point (F2) and ground in power supply 2A7.</p>	Differential voltmeter should indicate between +17.8 and +18.2 volts DC.	Replace power supply 2A7, and recheck.
1C          (Cont)	2A10J1 (H1)      2A10J3 (H3)	MC frequency stabilizer check	<p>Connect HP-410B VTVM between test point (H1) and ground in MC frequency stabilizer 2A10.</p> <p>Set MHZ frequency selector knob on radio set control to each MHZ position (2 through 29), and note VTVM reading.</p> <p>Connect HP-410B VTVM from test point (H3) to ground in MC frequency stabilizer 2A10.</p> <p>Set MHZ frequency selector knob on radio set control to 2-, 3-, 4-, 5-, and 6-MHZ position, and note VTVM reading.</p>	<p>VTVM should indicate between +6.0 and +7.6 volts DC at all MHZ positions.</p> <p>Same as above.</p>	<p>Perform step 11B of figure 8-66. Replace RF translator 2A12, and recheck.</p> <p>Replace MC frequency stabilizer 2A10, and recheck.</p> <p>Perform step 10B of figure 8-66. Replace RF translator 2A12, and recheck. Replace MC frequency stabilizer 2A10, and recheck.</p>

Figure 6-9. Minimum Performance Test Procedures (Sheet 2 of 11)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
1C (Cont)			Set MHZ frequency selector knobs on radio set control to 7-, 8-, 9- through 29-MHZ positions, and note VTVM reading.	VTVM should indicate less than 5.0 volts DC at all positions.	Same as above.
1D	2A12J5 (J5) 2A12J8 (J8)  2A12J8 (J8)	VFO 2A12A2 tracking check	Using test probe NO 2 (supplied in Electronic Equipment Maintenance Kit MK-825/ARM-86), connect the frequency counter to test point (J5) (VFO output).  Ground test point (J8) . This unlocks VFO 2A12A2.  Set frequency selector knobs on radio set control to each of the following frequencies, and observe counter indication: a. 2.999 MHZ b. 2.888 MHZ c. 2.777 MHZ d. 2.666 MHZ e. 2.555 MHZ f. 2.444 MHZ g. 2.333 MHZ h. 2.222 MHZ i. 2.111 MHZ j. 2.000 MHZ  Unground test point (J8) .  Set frequency selector knobs on radio set control to each of the following frequencies, and observe counter indication: a. 2.999 MHZ b. 2.888 MHZ c. 2.777 MHZ d. 2.666 MHZ e. 2.555 MHZ f. 2.444 MHZ g. 2.333 MHZ h. 2.222 MHZ i. 2.111 MHZ j. 2.000 MHZ	Counter should indicate as follows for each setting:  a. 2.499 to 2.503 MHZ b. 2.610 to 2.614 MHZ c. 2.721 to 2.725 MHZ d. 2.832 to 2.836 MHZ e. 2.943 to 2.947 MHZ f. 3.054 to 3.058 MHZ g. 3.165 to 3.169 MHZ h. 3.276 to 3.280 MHZ i. 3.387 to 3.391 MHZ j. 3.498 to 3.502 MHZ  Counter should indicate as follows for each setting:  a. 2.500997 to 2.501003 MHZ b. 2.611997 to 2.612003 MHZ c. 2.722997 to 2.723003 MHZ d. 2.833997 to 2.834003 MHZ e. 2.9449977 to 2.945003 MHZ f. 3.055997 to 3.056003 MHZ g. 3.166997 to 3.167003 MHZ h. 3.277997 to 3.278003 MHZ i. 3.388997 to 3.389003 MHZ j. 3.499997 to 3.500003 MHZ	Replace RF translator 2A12, and recheck.  Replace RF translator 2A12, and recheck.

Figure 6-9. Minimum Performance Test Procedures (Sheet 3 of 11)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
1E	2A12J5	VFO 2A12A2 capture range check	Frequency counter remains connected, through test probe NO 2, to test point (J5) .		Replace RF trans-lator 2A12, and recheck.
	(J5)		Set frequency selector knobs on radio set control to 2.999 MHZ.		
	2A1J2		Connect function test set GRND jack to radio receiver-transmitter chassis.		
	(A2)		Connect function test set J2-FREQ DIV jack to test point (A2) .		
	2A4J3		Connect function test set J3-KC STAB jack to test point (D3) .		
	(D3)		Ground test point (J8) to radio receiver-transmitter chassis.		
	2A12J8		Set function test set FUNCTION SE-LECTOR switch to 70K-5 CAPTURE RANGE position.		
	(J8)		Adjust function test set R3 for a frequency indication on counter between 3.5 and 4.0 KHZ higher than the nominal VFO frequency of 2.501 MHZ.		
	2A12J8		Without changing setting of function test set R3, unground test point (J8).		
	(J8)		Ground test point (J8) to radio receiver-transmitter chassis.		
	2A12J8		Adjust function test set R3 for a frequency indication on counter between 3.5 and 4.0 KHZ lower than the nominal VFO frequency of 2.501 MHZ.	Frequency indication should return to between 2.500992 and 2.501008 MHZ.	Continue test procedure.
	(J8)		Without changing setting of function test set R3, unground test point (J8)		
	(J8)		Same as above.		
(Cont)					

Figure 6-9. Minimum Performance Test Procedures (Sheet 4 of 11)

Figure 6-9. Minimum Performance Test Procedures (Sheet 5 of 11)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
2A (Cont)			<p>Repeat for each MHZ band from 2.100 through 28.100 and 29.900 MHZ. At each setting, remove modulation, and observe change in VTVM indication.</p> <p>Change signal generator output level from 3 to 5 UV with radio set control and signal generator at 2.100 MHZ, modulated 30 percent at 1000 HZ.</p> <p>Repeat for all frequencies listed above. Change signal generator output level from 5 to 50 UV with radio set control and signal generator set to 29.900 MHZ.</p> <p>Change signal generator output from 50 to 1000 UV.</p>	<p>Same as above for each band. Record indications for future use.</p> <p>AC VTVM should indicate not less than 3.9 V (50 MW into 300-ohm load).</p> <p>Same as above for each band.</p> <p>AC VTVM should indicate not less than 7.75 V (200 MW into 300-ohm load).</p> <p>AC VTVM indicates not less than 9.5 V (300 MW into 300-ohm load).</p>	<p>Same as above.</p> <p>Same as above.</p> <p>Same as above.</p> <p>Same as above.</p> <p>Same as above.</p>
B		SSB gain and sensitivity	<p>Set radio set control mode selector to USB and frequency selector knobs to 2.100 MHZ. Set signal generator for 1-UV output at 2.100 MHZ, unmodulated. Adjust signal generator frequency to provide maximum indication on AC VTVM.</p> <p>Remove input signal by tuning signal generator at least 10 KHZ off frequency.</p> <p>Readjust signal generator to frequency that provides maximum AC VTVM indication.</p> <p>Adjust signal generator output level for 3 UV with no modulation. Set radio set control mode selector to LSB. Adjust signal generator output level for 1 UV, unmodulated.</p> <p>Remove input signal by tuning signal generator at least 10 KHZ off frequency.</p> <p>Readjust signal generator to frequency which produces maximum VTVM indication.</p> <p>Adjust signal generator output level for 3 UV, unmodulated.</p> <p>Repeat entire step at 8.400 and 29.900 MHZ.</p>	<p>AC VTVM should indicate not less than 10-DB drop.</p> <p>AC VTVM indicates not less than 3.9 V (50 MW into a 300-ohm load).</p> <p>AC VTVM should indicate not less than 10-DB drop in signal.</p> <p>AC VTVM indicates not less than 3.9 V (50 MW into 300-ohm load).</p> <p>Same as above.</p>	<p>Replace RF translator 2A12, and recheck.</p> <p>Same as above.</p> <p>Same as above.</p> <p>Same as above.</p>

Figure 6-9. Minimum Performance Test Procedures (Sheet 6 of 11)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
2C		AGC characteristics	<p>Set radio set control mode selector to AM, frequency selector knobs to 7.300 MHZ.</p> <p>Set signal generator for 10-UV output at 7.300 MHZ, modulated 30 percent at 1000 HZ.</p> <p>Increase signal generator output to 100,000 UV.</p> <p>Set radio set control mode selector to USB. Set signal generator for 10-UV output at 7.300 MHZ, unmodulated.</p> <p>Adjust frequency of signal generator for maximum indication on AC VTVM.</p> <p>Increase signal generator output to 100,000 UV.</p>	<p>Record AC VTVM indication for reference.</p> <p>AC VTVM should indicate an increase of not more than 6 DB over reference.</p> <p>Record AC VTVM indication for reference.</p> <p>AC VTVM should indicate an increase of not more than 6 DB over reference.</p>	<p>Replace AM/audio amplifier 2A9, and recheck.</p> <p>Same as above.</p>
2D		Selectivity	<p>Set radio set control mode selector to AM, frequency selector knobs to 2.100 MHZ. Set signal generator to 2.100 MHZ modulated 30% at 1000 HZ. Set output level to provide 6.0-volt indication on AC VTVM.</p> <p>Increase signal generator output 60 DB as indicated by signal generator attenuator and meter setting, then tune signal generator above 2.100 MHZ until the AC VTVM indication drops back to 6.0 V. Remove modulation and use frequency counter to measure frequency. Increase signal generator level as necessary to drive counter.</p> <p>Lower the signal generator frequency below 2.100 MHZ until AC VTVM again indicates 6.0 V.</p> <p>Compute the difference between the two frequencies recorded.</p> <p>Set radio set control mode selector to USB. Set signal generator 2.100 MHZ unmodulated with an output level of 1 UV.</p> <p>Adjust signal generator frequency for maximum AC VTVM indication.</p> <p>Adjust signal generator output level for an AC VTVM indication of 6.0 V.</p>	<p>Note and record the frequency.</p> <p>Difference should be not more than 14 KHZ.</p>	<p>Replace AM/audio amplifier 2A9, and recheck.</p>
(Cont)					

Figure 6-9. Minimum Performance Test Procedures (Sheet 7 of 11)



STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
2D (Cont)			<p>Increase signal generator output 60 DB, and tune signal generator on each side of bandpass until the 6-volt reference audio output is repeated on each side.</p> <p>Compute difference between measured frequencies.</p> <p>Repeat with radio set control mode selector set to LSB.</p>	<p>At each 60-DB point, note and record frequency of signal generator.</p> <p>Difference should be no more than 6.3 KHZ.</p> <p>Same as USB results.</p>	<p>Replace IF translator 2A3, and recheck.</p> <p>Same as above.</p>
2E		Audio distortion	<p>Set radio set control mode selector to AM, frequency selector knobs to 7.300 MHZ. Set signal generator for 1,000-UV output at 7.300 MHZ, modulated 80% at 1000 HZ.</p> <p>Disconnect AC VTVM and connect distortion analyzer to HEADSET jack on radio set test harness, and measure distortion.</p> <p>Disconnect signal generator, frequency counter, and distortion analyzer.</p>	<p>Not more than 10 percent.</p>	<p>Replace AM/audio amplifier 2A9, and recheck.</p>
3		Transmitter tests	<p>Test equipment hookup is shown in figure 6-4.</p> <div style="text-align: center;">  <p><b>CAUTION</b></p> </div> <p>Ensure that BIRD 8201 Dummy Load is connected to radio receiver-transmitter test point</p> <div style="text-align: center;">  <p>1</p> </div> <p>during all transmitter tests.</p>		
3A		AM power output	<p>Set radio set control mode selector to AM, frequency selector knobs to 2.100 MHZ.</p> <p>Key radio receiver-transmitter and allow time for it to tune.</p> <p>Repeat above procedure at each MHZ frequency band from 3.100 to 28.100 MHZ and at 29.900 MHZ.</p> <p>Unkey radio receiver-transmitter.</p>	<p>VTVM should indicate 70 to 90 volts.</p> <p>Same as above.</p>	<p>Replace RF translator 2A12, and recheck.</p> <p>Same as above.</p>

Figure 6-9. Minimum Performance Test Procedures (Sheet 8 of 11)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
3B		Residual output voltage	<p>Set radio set control mode selector to AM, frequency selector knobs to 2.100 MHZ.</p> <p>Key radio receiver-transmitter and allow it to tune up. Unkey and set to USB. Key and record VTVM indication; unkey.</p> <p>Repeat with radio set control mode selector set to LSB.</p> <p>Unkey radio receiver-transmitter.</p>	<p>Not more than 25 volts.</p> <p>Same as above.</p>	<p>Replace IF translator 2A3, and recheck.</p> <p>Same as above.</p>
3C		SSB power output	<p>Set radio set control mode selector to AM, frequency selector knobs to 2.100 MHZ.</p> <p>Connect microphone to radio set test harness MIKE jack.</p> <p>Key radio receiver-transmitter and allow it to tune up. Unkey and set to USB. Key and speak into microphone.</p> <p>Unkey and set radio set control mode selector to AM, frequency selector knobs to 29.900 MHZ and repeat procedure.</p>	<p>VTVM should indicate 126 to 175 volts.</p> <p>Same as above.</p>	<p>Replace power amplifier 2A11, and recheck.</p> <p>Same as above.</p>
3D		Frequency accuracy	<p>Connect frequency counter through proper capacity divider (supplied in Electronic Equipment Maintenance Kit MK-825/ARM-86) to UG-274B/U adapter in RF output line.</p> <p>NOTE</p> <p>Use 2- to -8 MHZ capacity divider from 2.000 to 7.999 MHZ; 8- to -30 MHZ capacity divider from 8.000 to 29.999 MHZ.</p> <p>Set radio set control mode selector to AM, frequency selector knobs to 2.100 MHZ.</p> <p>Key and observe frequency counter indication. Unkey.</p> <p>Repeat for each MHZ band from 3.100 to 28.100 MHZ and 29.900 MHZ.</p>	<p>Frequency counter should indicate 2.100 MHZ <math>\pm 0.8</math> PPM.</p>	<p>Replace RF oscillator 2A2, and recheck.</p> <p>Replace KC frequency stabilizer 2A4, and recheck.</p>

Figure 6-9. Minimum Performance Test Procedures (Sheet 9 of 11)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
3E		Modulation capability	<p>Set up test equipment as shown in figure 6-6. Set radio set control mode selector to AM, frequency selector knobs to 7.300 MHZ.</p> <p>Set audio oscillator frequency to 2000 HZ, and adjust output level to minimum.</p> <p>Key radio receiver-transmitter.</p> <p>Slowly increase output level of audio oscillator until 85% modulation is noted on oscilloscope.</p> <p>NOTE</p> <p>An oscilloscope indication of a ratio of maximum peak-to-peak envelope height to minimum peak-to-peak envelope height is 12:1 at 85% modulation.</p> <p>Unkey.</p>	VTVM should indicate 0.25 volt or less as measured at 678Z-1 TEST POINT jack.	Replace IF translator 2A3, and recheck. Replace AM/audio amplifier 2A9 and recheck.
3F		Sidetone operation	<p>Set up test equipment as shown in figure 6-7. Set radio set control mode selector to USB, frequency selector knobs to 7.300 MHZ.</p> <p>Key radio receiver-transmitter, and speak into microphone</p> <p>Unkey radio receiver-transmitter, and disconnect microphone.</p>	Sidetone should be audible in headset.	Check sidetone circuit in radio receiver-transmitter chassis.
3G		Tune power check	<p>Connect test equipment as shown in figure 6-7.</p> <p>Set radio set control mode selector to USB, frequency control knobs to any frequency.</p> <p>Key radio receiver-transmitter using KEY switch on radio set test harness.</p> <p>Unkey radio receiver-transmitter.</p> <div style="border: 1px solid black; padding: 5px; text-align: center; margin: 10px 0;"> <b>CAUTION</b> </div> <p>Do not hold TUNE POWER switch in ON position for more than 20 seconds with radio receiver-transmitter keyed.</p> <p>Set TUNE POWER switch on radio set test harness to ON position, and key radio receiver-transmitter.</p> <p>Unkey radio receiver-transmitter.</p>	<p>VTVM should indicate 25 volts or less.</p> <p>Vtvm should indicate 55 volts or more. Tune tone should be between 5 and 20 milliwatts audio.</p>	<p>Replace IF translator 2A3, and recheck.</p> <p>Replace AM/audio amplifier 2A9, and recheck. If tune tone audio is greater than 20 milliwatts, check A9R57, should be 22K ohm.</p>

Figure 6-9. Minimum Performance Test Procedures (Sheet 10 of 11)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
4		FINAL ADJUSTMENTS			
4A		Receive audio output	<p>Connect test equipment as shown in figure 6-5. Set radio set control mode selector to AM, frequency selector knobs to 7.300 MHZ.</p> <p>Set RF SENS control on radio set control to full clockwise position.</p> <p>Set signal generator for 1000 UV output at 7.300 MHZ, modulated 30% at 1000 HZ.</p> <p>Tune signal generator around 7.300 MHZ to peak voltage on VTVM.</p> <p>Adjust AUDIO control 2R10 for 5.5 volts on AC VTVM.</p> <p>Set RF SENS control on radio set control to full counterclockwise position.</p>	VTVM indicates 0.1 volt or less.	
4B		Sidetone output level adjustment	<p>Connect test equipment as shown in figure 6-6.</p> <p>NOTE</p> <p>It is not necessary to connect oscilloscope for this test.</p> <p>Key radio receiver transmitter.</p> <p>Set audio oscillator to 2000 HZ, output level to 0.25 volt RMS as measured at function test set TEST POINT jack.</p> <p>Connect AC VTVM to radio set test harness HEADSET jack.</p> <p>Adjust SIDETONE level control 2R9 for 5.5 volts RMS at radio set test harness HEADSET jack.</p> <p>Connect AC VTVM to function test set TEST POINT jack.</p> <p>Key radio receiver-transmitter.</p> <p>Unkey.</p>	<p>Vtvm should indicate 0.25 volt RMS.</p> <p>NOTE</p> <p>Repeat adjustment of resistor 2R9 if necessary.</p>	
5		Disconnect	<p>Turn off all primary power.</p> <p>Disconnect all test equipment.</p> <p>Reinstall cover on radio receiver-transmitter.</p> <p>Perform pressurization procedure of paragraph 8-24.</p>		

Figure 6-9. Minimum Performance Test Procedures (Sheet 11 of 11)

## SECTION VII

### MAINTENANCE INSTRUCTIONS

### RADIO SET CONTROL C-4958/ARC-105

#### 7-1. GENERAL.

7-2. This section contains field maintenance instructions to properly maintain Radio Set Control C-4958/ARC-105. Information pertaining to circuit analysis, inspection, checkout and analysis, trouble isolation, and maintenance is presented in the paragraphs that follow. Refer to section I for an overall view of the radio set control and operating instructions. Radio Set Control, Schematic Diagram, figure 7-1, is the only illustration contained in this section.

#### 7-3. CIRCUIT OR ANALYSIS.

7-4. The radio set control (refer to figure 7-1) functions as an external remote control unit for the HF Radio Set. It controls the frequency and mode of operation and provides a means of adjusting the RF sensitivity of the receiver. It also monitors certain circuit conditions of the HF system. The front panel of the radio set control is illuminated by two panel lamps (1DS2 and 1DS3).

7-5. Frequency of operation is selected by four frequency selector controls: an MHZ control, 100-KHZ, 10-, and 1-KHZ controls. The MHZ control switch is a 28-position, 2-wafer switch (S1A and S1B). Switch S1A controls MHZ band motor 2A12B1, and switch S1B controls band relays in the antenna coupler control. The 100-KHZ control switch is a 10-position, 2-wafer switch (S2A and S2B). Switch S2A controls the 100-KHZ seeking switch in Autopositioner 2A12A1. Switch S2B works in conjunction with switch S1B to control a single relay in the antenna coupler control. The 10- and 1-KHZ control switches are 10-position, single-wafer switches. They control the 10- and 1-KHZ seeking switches in Autopositioner 2A12A1. The FREQ indicator provides a digital display of the frequency at which the HF Radio Set is operating.

7-6. Selection of the USB, LSB, or AM mode on the mode selector causes primary power to be applied to the radio receiver-transmitter. Mode control information, in the form of open or grounded circuits, is also applied to the mode selector relays in the radio receiver-transmitter at this time.

7-7. The RF SENS control is used to manually adjust the receiver sensitivity. It is not an audio level control. In operation, the RF SENS control acts as a variable resistor in a voltage divider network. The variable voltage controls the gain of the RF amplifiers and receive LF mixer in RF translator 2A12.

7-8. The RF TEST switch (1S6) is a double-pole, single-throw switch. When actuated, it provides a ground that enables the radio receiver-transmitter transmit circuits and the built-in test (BIT) circuits of the antenna coupler system. The RF IND lamp (1DS1) provides a visual indication if: The entire HF system is in operational readiness, a fault condition exists in the radio receiver-transmitter or antenna coupler system, or insufficient pressure is present in the antenna coupler. Refer to TO 12R2-2ARC105-2 for a complete description of the RF TEST switch, RF IND lamp, and their associated circuits.

#### 7-9. CHECKOUT ANALYSIS.

#### 7-10. PREPARATION FOR TEST PROCEDURES.

7-11. Perform the procedures of paragraphs 2-8, 2-9, and 2-10. A VTVM is the only test equipment required for the bench test.

#### 7-12. TEST PROCEDURE.

#### 7-13. FREQUENCY SELECTOR SWITCHES CHECK.

7-14. Operation of the frequency selector switches can be checked at any frequency using the VTVM and the information contained in figure 7-1. When the radio set control is operating properly, the control wire being checked at connector 1J1 will be grounded to the chassis for a frequency digit indicated by an X in figure 7-1. The control wire will be ungrounded for a frequency digit indicated by a 0 in figure 7-1. Also, all control wires for a specific frequency control setting (100 KHZ, 10 KHZ, etc) followed by a 0 in a single vertical (frequency digit) column will be electrically connected. If abnormal indications are obtained, refer to figure 7-1, and trace the open or short circuit. The following example will aid in understanding figure 7-1.

a. Set the VTVM to function as an ohmmeter. Set the radio set control to 2 MHZ.

b. Refer to the megahertz control setting portion of the chart for the radio set control.

c. Connect the ohmmeter from ground (1J1-r) to 1J1-A. The horizontal row for control wire A contains the letter X under the numeral 2. This indicates that the ohmmeter should read 0 ohm with the MHZ frequency control set at 2 MHZ.

d. At this same frequency setting, 1J1-B, 1J1-C, 1J1-D, and 1J1-E should be open to 1J1-r but connected together.

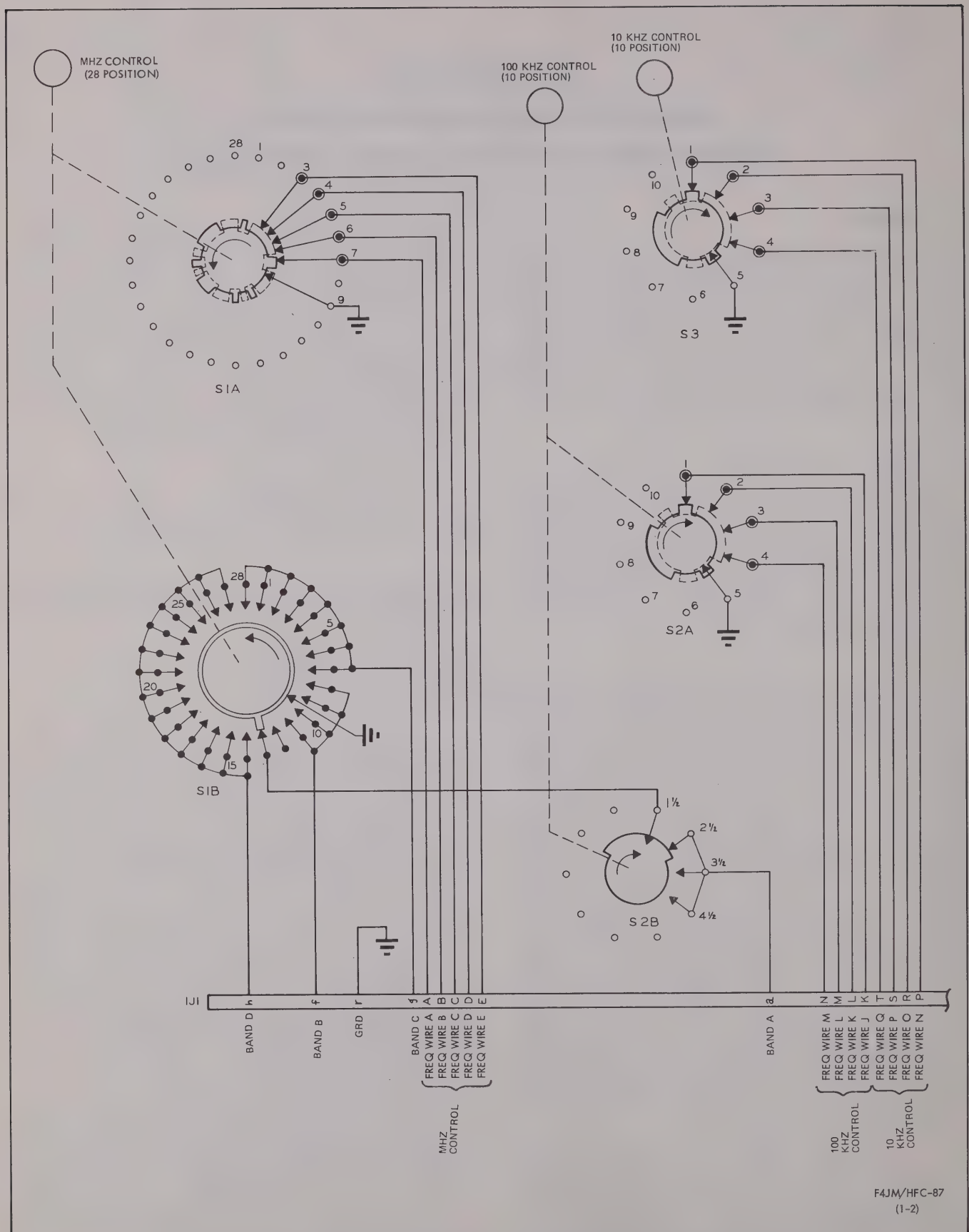


Figure 7-1. Radio Set Control, Schematic Diagram (Sheet 1 of 2)

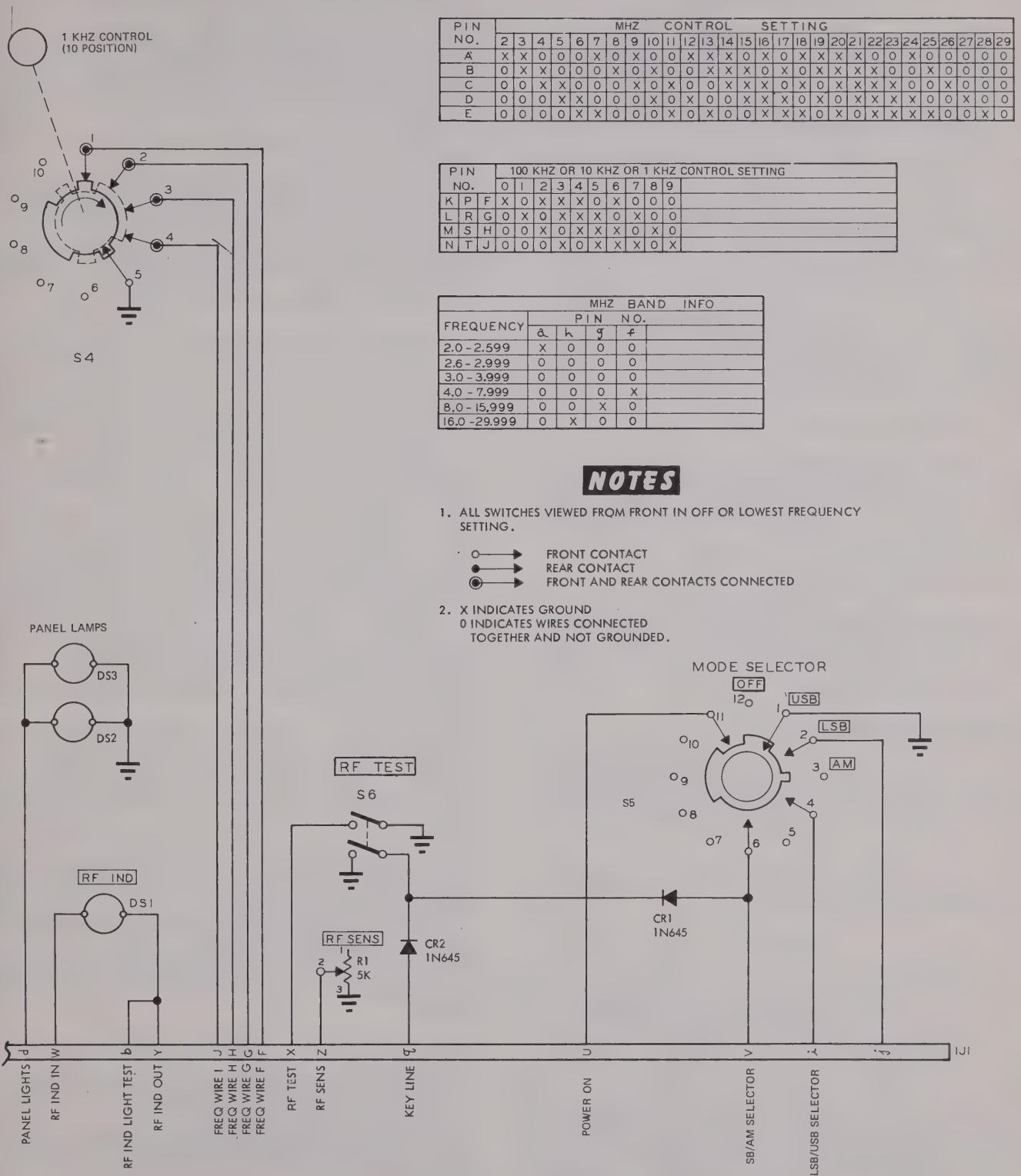


Figure 7-1. Radio Set Control, Schematic Diagram (Sheet 2 of 2)

**7-15. MODE SELECTOR SWITCH CHECK.**

7-16. The mode selector switch should be checked for continuity using the chart contained in figure 7-1. Check continuity between applicable pins on connector 1J1 and chassis while switching the mode selector switch through each position.

**7-17. RF SENS CONTROL CHECK.**

7-18. Using the ohmmeter, the range of resistance should be 0 to 5000 ohms with no intermittent action.

**7-19. RF TEST SWITCH CHECK.**

7-20. The RF TEST switch should be checked for continuity. Check continuity between applicable pins of connector 1J1 and chassis while actuating the RF TEST switch.

**7-21. RF IND AND PANEL LAMP CHECK.**

7-22. The RF IND and panel lamps should be checked for continuity. Check continuity between applicable pins of connector 1J1 for RF IND lamp and between 1J1 and chassis for panel lamps.

**7-23. TROUBLE ANALYSIS.**

7-24. Due to the relative simplicity of the radio set control, a VTVM and the schematic diagram (figure 7-1) will provide all necessary data for troubleshooting of this equipment.

**7-25. DISASSEMBLY.**

7-26. REMOVAL OF THE REAR COVER AND FRONT, REAR, AND BOTTOM PANELS. Refer to paragraph 2-10, steps a through g for this disassembly procedure.

7-27. REMOVAL OF THE MHZ SWITCH ASSEMBLY. The procedures are as follows:

**NOTE**

The MHZ, 100-, 10-, and 1-KHZ switches need not be removed if wafers are to be replaced. Individual wafers may be removed with the switch in place.

- a. Remove the back screw from each of the three posts supporting the L-shaped bracket holding the MHZ switch.
- b. Tag the leads to the switch and unsolder them.
- c. Pull the MHZ switch and L-shaped bracket out of the assembly. The drive gear on the switch remains attached.

7-28. REMOVAL OF THE 100-, 10-, AND 1-KHZ SWITCH ASSEMBLIES. The switches are all removed in the same general manner. One exception,

the 1-KHZ switch, is explained in step a below.

- a. Remove the pin retaining the bevel gear on the 1-KHZ switch shaft. The helical gears on the 100- and 10- switch shafts are retained by Bristo setscrews. Loosen both setscrews on the gear.

- b. Tag the leads to be removed from the switch and unsolder them.

- c. Completely loosen the 1/2-inch nut on the switch shaft to be removed.

- d. Pull the switch assembly out from the rear. There is very little working area for removal of the 100-KHZ switch because of the L-shaped bracket supporting the MHZ switch. If desired, the MHZ switch may be removed before the 100-KHZ switch to provide more room to work.

7-29. REMOVAL OF THE MODE SELECTOR SWITCH. The procedures are as follows:

- a. Tag the mode selector switch leads and unsolder them.

- b. Remove the 1/2-inch hexnut and washer holding the mode selector switch to the front panel.

- c. Remove the mode selector switch from the rear.

7-30. REMOVAL OF THE OPERATING FREQUENCY INDICATOR ASSEMBLY. The operating frequency indicator assembly can be removed with the frequency select switches attached or after all frequency select switches have been removed. To remove the operating frequency indicator assembly with the frequency select switches attached, proceed as follows:

- a. Remove the roundhead Phillips screws that hold the operating frequency indicator assembly to the front subpanel.

- b. After tagging, unsolder wires to the panel lamp sockets, RF SENS control, mode selector switch, and RF TEST switch as necessary so the operating frequency indicator assembly and frequency select switches can be removed as a unit.

7-31. REMOVAL OF THE RF SENS CONTROL. The procedures are as follows:

- a. Remove the hexnut and washer retaining the RF SENS control to the front panel.

- b. The RF SENS control may be pulled out of the subpanel before unsoldering the wires to allow easier access.

7-32. REMOVAL OF THE RF TEST SWITCH. The procedures are as follows:

- a. Remove the hexnut and washer retaining the RF TEST switch to the front panel.

- b. The RF TEST switch may be pulled out of the subpanel before unsoldering the wires to allow easier access.

**7-33. INSPECTION, CLEANING AND REPAIR.**

7-34. Upon completion of the disassembly procedures, perform the cleaning, inspection, and repair and replacement procedures as necessary of section X, overhaul instructions.

## 7-35. LUBRICATION.

7-36. Lubricate the radio set control as follows:  
a. With a small stiff-bristled brush, apply MIL-G-3278 grease very sparingly to gear teeth and switch detents.

### NOTE

Excessive application of oil or grease may result in a malfunction.

- b. With a dropper, apply MIL-L-6085A oil very sparingly to sleeve bearings.
- c. Apply alcohol to switch contacts with a small soft-bristled brush.

## 7-37. REASSEMBLY.

7-38. REPLACEMENT OF THE RF TEST SWITCH. Reverse the procedure given in paragraph 7-32.

7-39. REPLACEMENT OF THE RF SENS CONTROL. Reverse the procedure given in paragraph 7-31.

7-40. REPLACEMENT OF THE OPERATING FREQUENCY INDICATOR ASSEMBLY. Reverse the procedure given in paragraph 7-29.

7-41. REPLACEMENT OF THE MODE SELECTOR SWITCH. Reverse the procedure given in paragraph 7-29.

7-42. REPLACEMENT OF THE 1-, 10-, and 100-KHZ SWITCH ASSEMBLIES. The procedures are as follows:

- a. Set the switch for minimum (0) frequency (refer to figure 7-1).
- b. Reverse the procedure given in paragraph 7-28. Make sure necessary gears and hardware are placed on the shaft between the operating frequency indicator assembly and the front panel. For the 1-KHZ switch, tighten the hexnut holding the shaft, and install the pin holding the bevel gear to the 1-KHZ switch shaft.

### NOTE

Before tightening the setscrews or replacing the pins in the switch drive gear, set the frequency select knob for 0 on the appropriate digit of the operating frequency indicator assembly, and install the setscrews or pins in the switch drive gear.

7-43. REPLACEMENT OF THE MHZ SWITCH ASSEMBLY. The procedures are as follows:

- a. Set the MHZ switch to the full counterclockwise (2-MHZ) position (refer to figure 7-1).
- b. Reverse the procedure given in paragraph 7-27.

## NOTE

Before tightening the setscrews on the MHZ switch drive gear, set the MHZ select control for 02 on the first two digits of the operating frequency indicator (full counterclockwise), and tighten the setscrews on the MHZ switch drive gear.

7-44. REPLACEMENT OF THE REAR COVER, FRONT, REAR, AND BOTTOM PANELS. Reverse the procedure given in paragraph 2-10, steps a through g.

## 7-45. ALIGNMENT.

7-46. Upon completion of the reassembly procedures, perform the alignment procedures of the following paragraphs.

7-47. MHZ SWITCH ALIGNMENT. If the MHZ display on the operating frequency indicator assembly is inaccurate, proceed as follows:

- a. Remove the rear cover.
- b. Set the MHZ select control to full counterclockwise position. The operating frequency indicator should indicate 02 on the first two digits.
- c. Compare the MHZ switch wafers to determine the amount of misalignment. Note that the switch is viewed from the driven end on the schematic diagram.
- d. Loosen the two setscrews on the bevel gear attached to the operating frequency indicator assembly shaft. Remove the mode selector switch to gain access to these setscrews from below.
- e. Position the MHZ switch to the 2-MHZ position using the MHZ selector control. Position the first two indicators (use fingers) so 02 is centered in the window.
- f. Tighten the two setscrews loosened in step d, and replace the mode selector switch if it has been removed.
- g. Replace the rear cover.
- h. Perform the test procedures, paragraphs 7-12 through 7-22, to be sure the radio set control is operating properly.

7-48. 100-, 10-, AND 1-KHZ ALIGNMENT. If any of the KHZ displays on the operating frequency indicator assembly are inaccurate, proceed as follows:

- a. Remove the rear cover.
- b. Set the three KHZ select controls for 0 on the last three digits of the operating frequency indicator.
- c. Compare switch wafers with figure 7-1 to determine the amount of misalignment. Note that the switch is viewed from the driven end on the schematic diagram.
- d. If the 1-KHZ switch is misaligned, loosen the two setscrews on the bevel gear attached to the operating frequency indicator assembly shaft. Remove the right-hand panel lamp socket to gain access to these setscrews from below.

- e. If the 10- or 100-KHZ switch is misaligned, loosen the two setscrews in the helical gears on the switch shaft.
- f. Position the switch to the 0 position using the appropriate knob. Position the indicator (use fingers) so that a 0 is centered in the window.
- g. Tighten the two setscrews loosened in step d and/or e. Replace the right-hand panel lamp socket that was removed in step d.
- h. Replace the rear cover.
- i. Perform the test procedure paragraphs 7-12 through 7-22 to be sure the radio set control is operating properly.

#### **7-49. MODIFICATION HISTORY.**

7-50. GENERAL. The following paragraph contains the modification history for RadioSetControl C-4958/ARC-105.

7-51. RADIO SET CONTROL C-4958/ARC-105. The modification history consists of changes made at MCN 107. These changes are as follows:

- a. Added circuit from switch 1S2B-4-1/2 to switch 1S2B-3-1/2.
- b. Changed switch contact 1S2B-1-1/2 from short clip to long clip.
- c. Changed rotor configuration of switch 1S2B.

## SECTION VIII

# MAINTENANCE INSTRUCTIONS

### 8-1. GENERAL.

8-2. This section contains field maintenance procedures and instructions for Radio Receiver-Transmitter RT-712/ARC-105. The first part of the section includes theory of operation and maintenance instructions required to localize trouble to a replaceable module or to the chassis assembly and the necessary test procedures required to assure maintenance personnel that a repaired RT-712/ARC-105 is functioning within acceptable limits of performance. Localization of trouble to a detail part within a module

and adjustment and realignment instructions for the modules are contained in separate subsections. A separate subsection of module theory and maintenance is provided for each module.

8-3. Trouble isolation procedures described in this section assume that the trouble has been isolated to the radio receiver-transmitter. All maintenance procedures and test procedures contained in this section can be performed using the test equipment and tools listed in section III. The following illustrations and tables are used in this section:

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#### 8-4. CIRCUIT ANALYSIS OF CHASSIS MOUNTED CIRCUITS.

##### 8-5. GENERAL.

8-6. The radio receiver-transmitter chassis mounted circuits perform power distribution, time delay, keying (transmit/receive switching), sidetone, recycle, and antenna transfer functions.

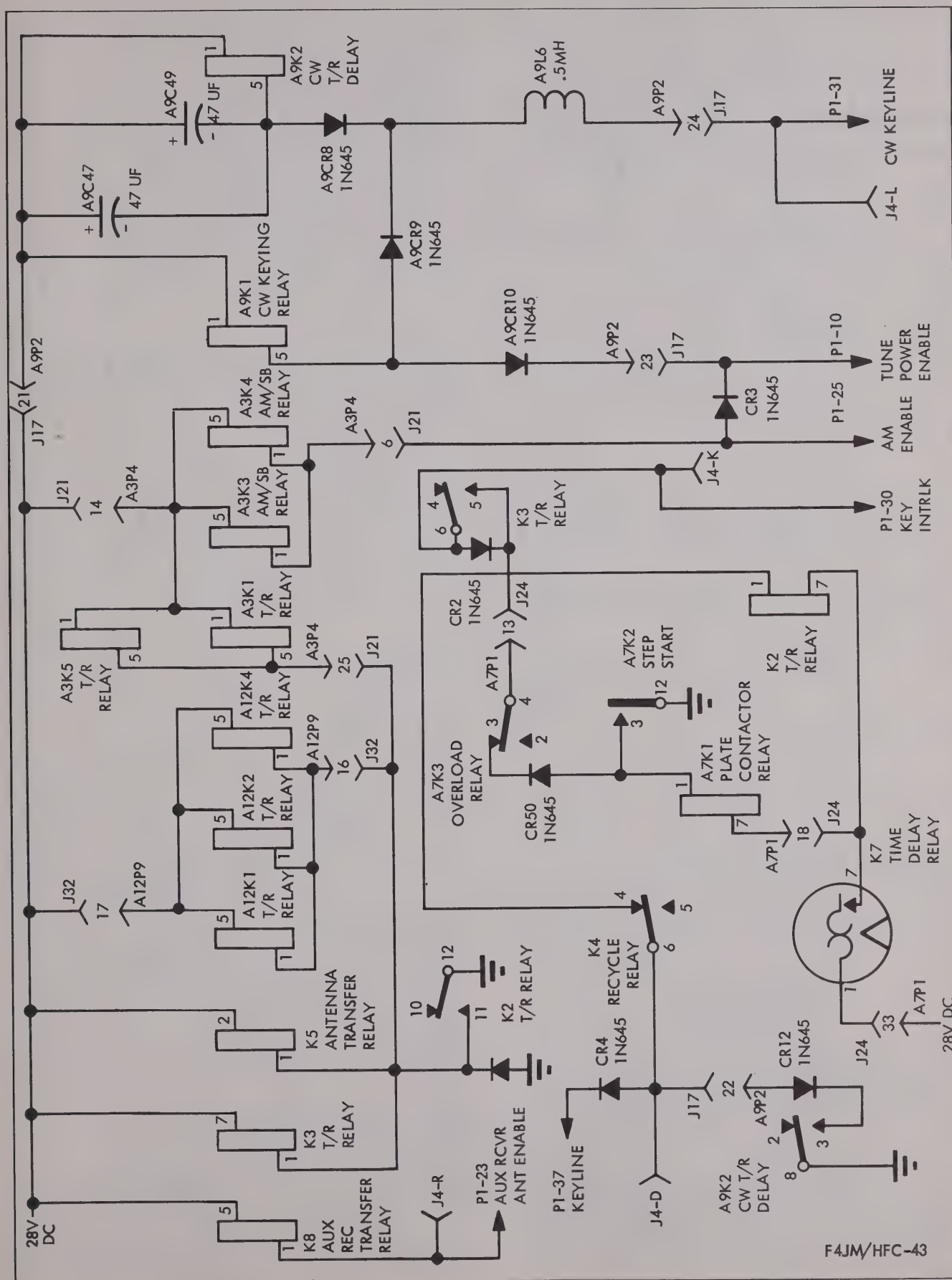
8-7. POWER DISTRIBUTION. The power distribution circuits are activated when the mode selector on the radio set control is switched from the OFF position. The 115-volt, 400-HZ, 3-phase primary power is applied to power supply 2A7 which supplies the operating voltages for the radio receiver-transmitter.

8-8. TIME DELAY. Selection of an operating frequency causes resistor 2TB2R22 and capacitor 2TB2C13 in unijunction transistor stage 2TB2Q1 to delay the energizing of relay 2K10 for 1/2 second after the deenergizing of recycle relay 2K4. Delay interlock relay 2K10 disables the frequency stabilizing circuits. Because operating frequency changes appear as drift to the frequency stabilizing circuits, the stabilizing circuits must be disabled to prevent an attempted phase lock on an erroneous spectrum point.

8-9. KEYING (Refer to figures 8-1 and 8-2.) The major keying function is the transfer of circuits from receive mode to transmit mode. When the radio receiver-transmitter is keyed, the following action occurs:

- AM/audio amplifier 2A9 is switched to a speech amplifier function.
- Two receive stages are bypassed in IF translator 2A3.
- The receive mixers in RF translator 2A12 are switched out.
- The transmit mixers in RF translator 2A12 are switched in.
- The antenna transfer relay operates, and the RF driver is coupled to the rf amplifiers.
- Voltage is applied to the plates and screens of the power amplifier tubes.
- The 500-KHZ carrier is removed from the product detector and applied to the balanced modulator for sideband generation by energizing relay 2A3K1.

8-10. Keying of the radio receiver-transmitter after a frequency change causes the power amplifier output circuit and antenna coupler to fine tune. Keying provides RF to the antenna coupler, and a 1-KHZ tone in the headset indicates the tune power cycle. The antenna coupler locks the key line so that it remains



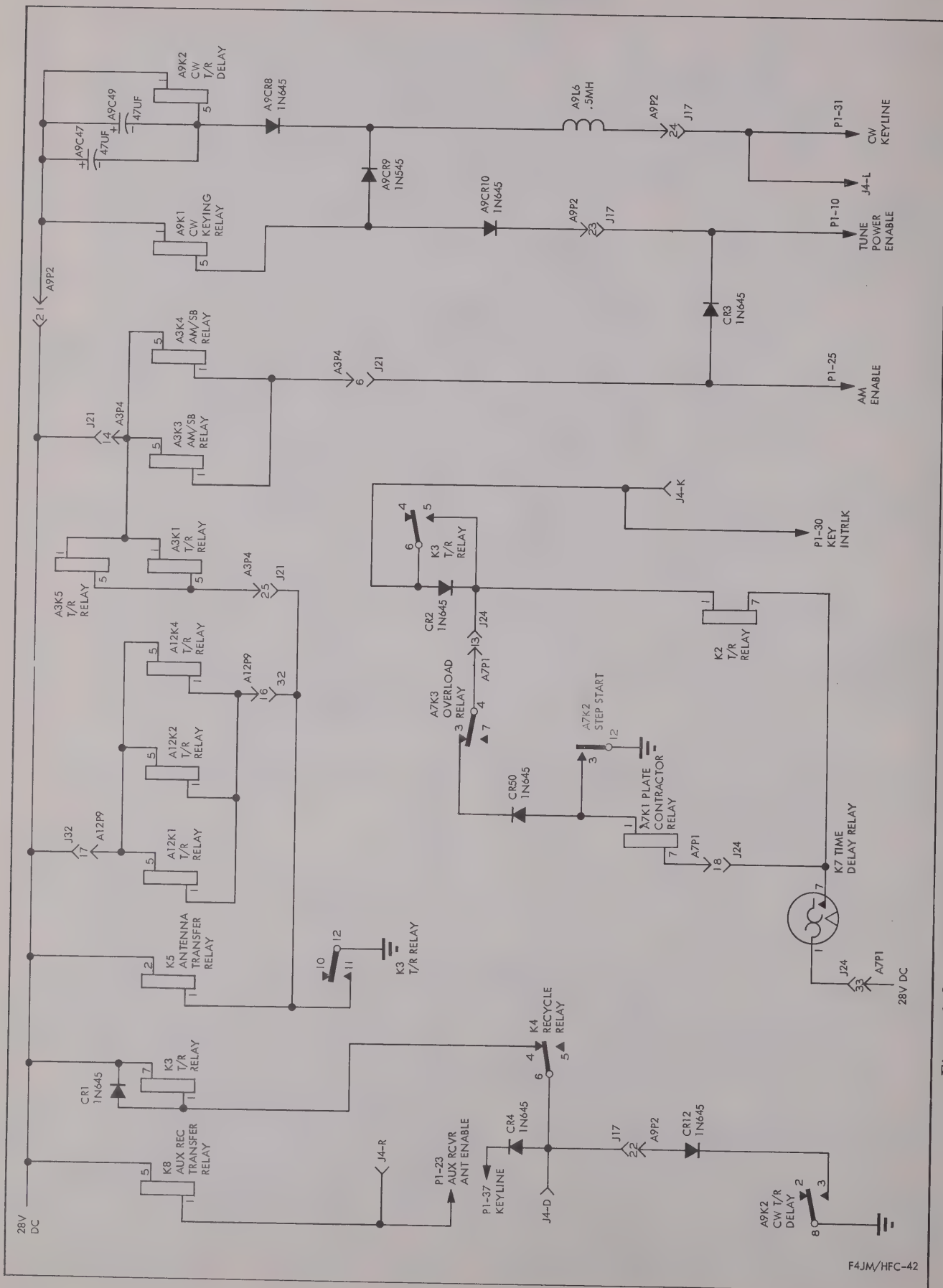


Figure 8-2. Keying Circuits, Simplified Schematic Diagram (APE 80 (MCN 230) and Subsequent, APE 1 Through APE 79 After Incorporation of ECN 43)

closed until the power amplifier roller coil has tuned for 180 degrees difference between grid and plate circuit and the antenna coupler has tuned for minimum VSWR (1.3:1). During tuning, the transmitter output circuit is placed in series with a load resistor to help stabilize transmitter load and protect the transmitter and antenna tuning elements. The position of the function selector switch on the radio set control is not important during this tuning function since the AM mode is selected internally to provide the necessary carrier for phase and VSWR differentiation for tuning. After power amplifier 2A11 and the antenna coupler are tuned, the key line opens, and the mode of operation is again under the control of the function selector switch.

8-11. Recycle relay 2K4 is a part of keying function so that a transmission cannot be made during a change of frequency. Keying is accomplished by depressing the push-to-talk switch on the microphone. Protective circuits include overload relay 2A7K3 and step-start relay 2A7K2 that switches current-limiting resistors in each leg of the incoming AC line to prevent surges before tube warmup. If a frequency change is made while keying, the key line is interrupted, recycle takes place, and, after the frequency change is completed, the key line closes again. Then, RF (tune power) is applied with the key locked while the power amplifier roller coil and antenna coupler retune to the new frequency. The key then opens again, and a transmission may be made.

8-12. SIDETONE. (Refer to figure 8-3.) The sidetone signal is taken from audio amplifier 2A9Q2 to provide audio monitoring in the transmit mode. The audio signal from the audio amplifier is applied through keying relay 2K3 to the sidetone level adjust network and then to sidetone relay 2K6 to the audio output. A combination of two voltages is necessary to energize the sidetone relay. One voltage is derived from the RF output of power amplifier 2A11. When antenna transfer relay 2K5 is energized, this RF output is rectified by diode 2CR8 and applied to zener diode 2CR9. When the RF output is sufficient, zener diode 2CR9 will break down and permit Q2 to conduct. A ground path is provided to the cathode of SCR 2Q2 through the energized contacts of TR relay 2K2 and the normally closed contact of pressure switch 2S1. The second voltage is tapped from transformer 2T1 and applied to the anode of SCR 2Q2 through relay 2K6. Capacitor 2C7 is placed in the input of SCR 2Q2 to keep it operating in the sideband transmit mode when the RF output varies with the applied audio signal.

8-13. RECYCLE. (Refer to figure 8-4.) The recycle circuits are activated when any of the frequency select controls on the radio set control are repositioned. When Autopositioner 2A12A1 operates, recycle relay 2K4 is energized. This relay remains energized as long as any of the tuning motors in the radio receiver-transmitter are operating. The recycle relay has the following functions:

- a. Disconnects transistor supply voltage to AM/audio amplifier 2A9 in order to mute the audio during the tuning cycle.
- b. Provides a ground to activate the antenna coupler system rechannel circuits.
- c. Interrupts the operation of KC frequency stabilizer 2A4 during the tune cycle.
- d. Disconnects the key line so that the transmitter cannot be keyed during the tuning cycle.

#### 8-14. TESTING AND TROUBLE ANALYSIS.

8-15. Due to the simplicity of the chassis-mounted circuits, a continuity check is the only test required. Use the schematic diagram (figure 8-8) to perform this test, and take corrective action if necessary. Chassis test-point and component location data is contained in figure 8-5. A list of all test points utilized to test the radio receiver-transmitter is contained in figure 8-6.

#### 8-16. DISASSEMBLY.

8-17. To remove the cover and modules from the radio receiver-transmitter, perform the procedures of paragraph 2-3. Module disassembly information is contained in the applicable module subsection.

#### 8-18. INSPECTION, CLEANING, AND REPAIR.

8-19. Refer to section X for inspection, cleaning, and repair information.

#### 8-20. ASSEMBLY.

8-21. REPLACEMENT OF MODULE COVERS, MODULES, AND COVERS.

8-22. Replace module covers, modules, and covers as follows:

- a. Replace module covers by performing the reverse of the removal procedure described in section II.
- b. Replace radio receiver-transmitter modules by carefully engaging aligning pins and connectors on the module and push in to seat the module firmly in the chassis.



Be certain that all connectors are aligned properly before seating the module. Connectors may be damaged if they are not mated properly.

- c. Replace radio receiver-transmitter and radio set control covers by cleaning the sealing edge of the cover with Flourolube GR-470 and performing the reverse of the removal procedure described in section II.

**NOTES**

- 1 APE 1 THRU APE 79 BEFORE INCORPORATION OF ECN 43.
- 2 APE 80 AND SUBSEQUENT. APE 1 THRU APE 79 AFTER INCORPORATION OF ECN 43.

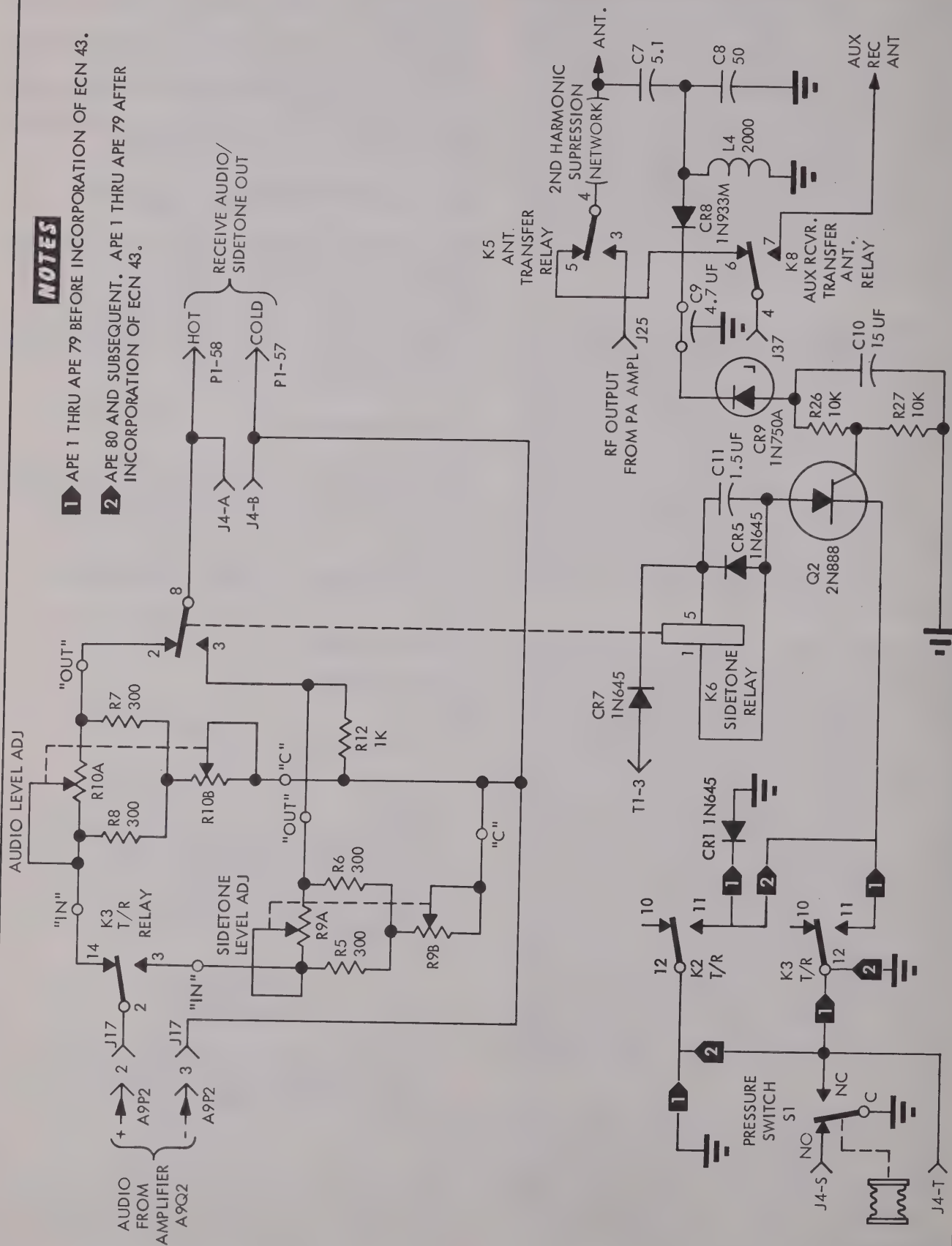


Figure 8-3. Sidetone Circuits, Simplified Schematic Diagram

F4JM/HFC-45

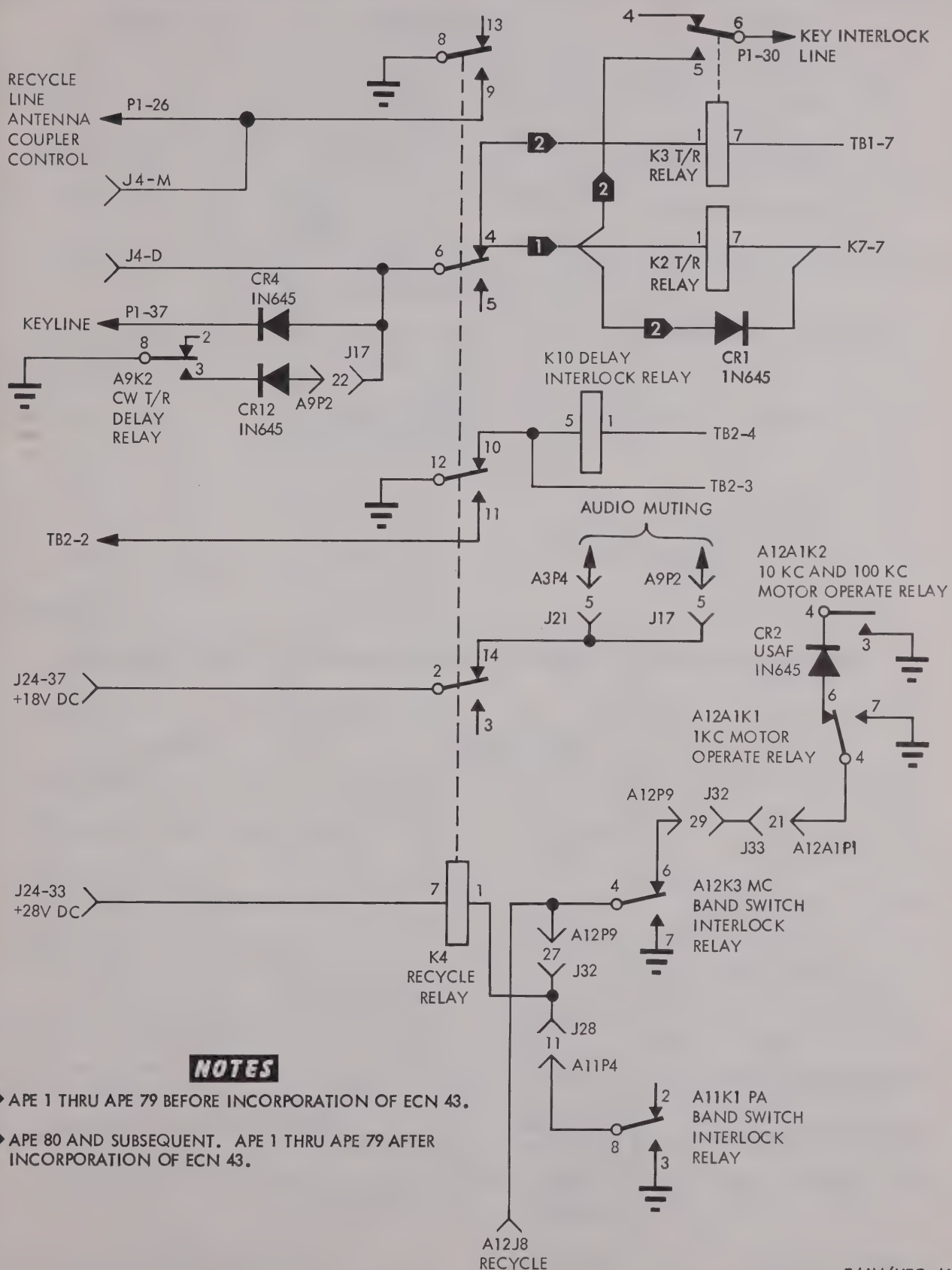
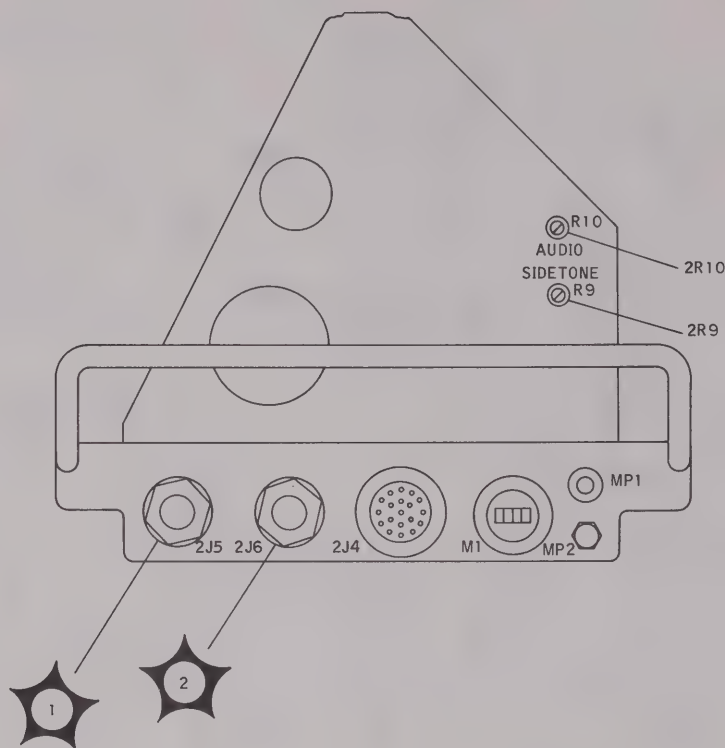


Figure 8-4. Recycle Circuits, Simplified Schematic Diagram

F4JM/HFC-46



TPI-9308-012

Figure 8-5. Radio Receiver-Transmitter Chassis, Test-Point and Component Location









NAME	REFERENCE DESIGNATION	LOCATION
Antenna connector	2J5 	Main chassis assembly (figure 8-5).
Auxiliary receive antenna	2J6 	Main chassis assembly (figure 8-5).
10-KHZ reference pulse	2A1J1 	Frequency divider 2A1 (figure 8-12).
+18 volts DC	2A1J2 	Frequency divider 2A1 (figure 8-12).
1-KHZ reference spectrum	2A1J3 	Frequency divider 2A1 (figure 8-12).
1-KHZ time tone	2A1J4 	Frequency divider 2A1 (figure 8-12).
Keyed oscillator output	Collector of transistor 2A1Q12 	Frequency divider 2A1 (figure 8-12).
100-KHZ reference	2A2J1 	RF oscillator 2A2 (figure 8-17).

Figure 8-6. Radio Receiver-Transmitter, List of Test Points (Sheet 1 of 5)

NAME	REFERENCE DESIGNATION	LOCATION
+18 volts DC	2A2J2 (B2)	RF oscillator 2A2' (figure 8-17).
500-KHZ reference	2A2J3 (B3)	RF oscillator 2A2 (figure 8-17).
500-KHZ carrier	2A2J4 (B4)	RF oscillator 2A2 (figure 8-17).
+17.1 volts DC	Junction of 2A2L9 and 2A2C38 (B5)	RF oscillator 2A2 (figure 8-17).
3-MHZ output of temperature compensated crystal oscillator	Junction of 2A2Q4 and 2A2R24 (B6)	RF oscillator 2A2 (figure 8-17).
Transistor 2A2Q5	Junction of 2A2R34 and 2A2Q7 (B7)	RF oscillator 2A2 (figure 8-17).
IF AGC	2A3J1 (C1)	IF translator 2A3 (figure 8-25).
TGC voltage	2A3J2 (C2)	IF translator 2A3 (figure 8-25).
Transmit audio	2A3J3 (C3)	IF translator 2A3 (figure 8-25).
Input from VFO	2A4E1J1 (D1)	KC frequency stabilizer 2A4 (figure 8-31).
+18 volts DC	2A4E1J2 (D2)	KC frequency stabilizer 2A4 (figure 8-31).
VFO bias supply	2A4J3 (D3)	KC frequency stabilizer 2A4 (figure 8-31).
10-KHZ control bias	2A4E3J4 (D4)	KC frequency stabilizer 2A4 (figure 8-31).
Digit oscillator output	2A4E1J5 (D5)	KC frequency stabilizer 2A4 (figure 8-31).
Digit oscillator DC tuning voltage	2A4E4J6 (D6)	KC frequency stabilizer 2A4 (figure 8-31).
Signal channel IF input	2A4J7 (D7)	KC frequency stabilizer 2A4 (figure 8-31).
Reference channel IF input	2A4J8 (D8)	KC frequency stabilizer 2A4 (figure 8-31).
Isolation amplifier output	2A4E1TP1 (D9)	KC frequency stabilizer 2A4 (figure 8-31).
Mixer output	2A4E1TP2 (D10)	KC frequency stabilizer 2A4 (figure 8-31).
IF amplifier output	2A4E2TP4 (D11)	KC frequency stabilizer 2A4 (figure 8-31).

Figure 8-6. Radio Receiver-Transmitter, List of Test Points (Sheet 2 of 5)

NAME	REFERENCE DESIGNATION	LOCATION
250-KHZ IF	2A4E2TP5 (D12)	KC frequency stabilizer 2A4 (figure 8-31).
Frequency discriminator output	2A4E2TP7 (D13)	KC frequency stabilizer 2A4 (figure 8-31).
Spectrum generator output	2A4E3TP8 (D14)	KC frequency stabilizer 2A4 (figure 8-31).
Keyed oscillator supply voltage	2A4E3TP9 (D15)	KC frequency stabilizer 2A4 (figure 8-31).
Keyed oscillator output voltage	2A4E3TP10 (D16)	KC frequency stabilizer 2A4 (figure 8-31).
10-KHZ pulse input	2A4E3TP11 (D17)	KC frequency stabilizer 2A4 (figure 8-31).
Reference mixer input	2A4E5TP12 (D18)	KC frequency stabilizer 2A4 (figure 8-31).
Reference IF amplifier input/output	2A4E6TP14 (D19)	KC frequency stabilizer 2A4 (figure 8-31).
Phase discriminator reference input	2A4E6TP15 (D20)	KC frequency stabilizer 2A4 (figure 8-31).
Phase discriminator input	2A4E6TP16 (D21)	KC frequency stabilizer 2A4 (figure 8-31).
Phase discriminator output	2A4E6TP17 (D22)	KC frequency stabilizer 2A4 (figure 8-31).
Phase discriminator output	2A4E6TP18 (D23)	KC frequency stabilizer 2A4 (figure 8-31).
Keyer output	2A4E3TP19 (D24)	KC frequency stabilizer 2A4 (figure 8-31).
Amplifier 2A6Q1 output	2A6J1 (E1)	Electronic control amplifier 2A6 (figure 8-35).
Amplifier 2A6Q4 output	2A6J2 (E2)	Electronic control amplifier 2A6 (figure 8-35).
Push-pull amplifier output	2A6J3 (E3)	Electronic control amplifier 2A6 (figure 8-35).
Push-pull amplifier output	2A6J4 (E4)	Electronic control amplifier 2A6 (figure 8-35).
+250 volts DC	2A7J1 (F1)	Power supply 2A7 (figure 8-39).
+18 volts DC	2A7J2 (F2)	Power supply 2A7 (figure 8-39).
+32 volts DC	2A7J3 (F3)	Power supply 2A7 (figure 8-39).
+130 volts DC	2A7J4 (F4)	Power supply 2A7 (figure 8-39).
+28 volts DC	2A7J5 (F5)	Power supply 2A7 (figure 8-39).

Figure 8-6. Radio Receiver-Transmitter, List of Test Points (Sheet 3 of 5)

NAME	REFERENCE DESIGNATION	LOCATION
IF AGC	2A9J1 (G1)	AM/audio amplifier 2A9 (figure 8-41).
AM receiver audio	2A9J2 (G2)	AM/audio amplifier 2A9 (figure 8-41).
Transmit audio in	2A9J3 (G3)	AM/audio amplifier 2A9 (figure 8-41).
IF AGC	2A9J4 (G4)	AM/audio amplifier 2A9 (figure 8-41).
RF AGC	2A9J5 (G5)	AM/audio amplifier 2A9 (figure 8-41).
Output of 2A9Q9	2A9J6 (G6)	AM/audio amplifier 2A9 (figure 8-41).
8.5 to 16-MHZ DC control	2A10J1 (H1)	MC frequency stabilizer 2A10 (figure 8-52).
+18 volts DC	2A10J2 (H2)	MC frequency stabilizer 2A10 (figure 8-52).
17.5-MHZ DC control	2A10J3 (H3)	MC frequency stabilizer 2A10 (figure 8-52).
8.5 to 16 MHZ RF	2A10J4 (H4)	MC frequency stabilizer 2A10 (figure 8-52).
17.5 MHZ RF	2A10J5 (H5)	MC frequency stabilizer 2A10 (figure 8-52).
Squaring amplifier output	2A10A3TP1 (H6)	MC frequency stabilizer 2A10 (figure 8-52).
Pulse generator output	2A10A3TP2 (H7)	MC frequency stabilizer 2A10 (figure 8-52).
Mixer input	2A10A3TP3 (H8)	MC frequency stabilizer 2A10 (figure 8-52).
Mixer output	2A10A1TP4 (H9)	MC frequency stabilizer 2A10 (figure 8-52).
Mixer input	Junction of 2A10A2R9 and 2A10A2R10 (H10)	MC frequency stabilizer 2A10 (figure 8-52).
Mixer output	2A10A2TP4 (H11)	MC frequency stabilizer 2A10 (figure 8-52).
Grid bias voltage	2A11J1 (I1)	Power amplifier 2A11 (figure 8-58).
TGC reference	2A11J2 (I2)	Power amplifier 2A11 (figure 8-58).

Figure 8-6. Radio Receiver-Transmitter, List of Test Points (Sheet 4 of 5)

NAME	REFERENCE DESIGNATION	LOCATION
Screen voltage	2A11J3 (I3)	Power amplifier 2A11 (figure 8-58).
Bias voltage	2A11J4 (I4)	Power amplifier 2A11 (figure 8-58).
ADC voltage	2A11J5 (I5)	Power amplifier 2A11 (figure 8-58).
17.5-MHZ oscillator output	2A12J1 (J1)	RF translator 2A12 (figure 8-67).
Transmit RF mixer	2A12J2 (J2)	RF translator 2A12 (figure 8-67).
RF amplifier grid bias	2A12J3 (J3)	RF translator 2A12 (figure 8-67).
Driver grid bias	2A12J4 (J4)	RF translator 2A12 (figure 8-67).
VFO supply voltage	2A12J5 (J5)	RF translator (figure 8-67).
Receiver 17.5-MHZ mixer output	2A12J6 (J6)	RF translator 2A12 (figure 8-67).
HF oscillator output	2A12J7 (J7)	RF translator 2A12 (figure 8-67).
Recycle line	2A12J8 (J8)	RF translator 2A12 (figure 8-67).

Figure 8-6. Radio Receiver-Transmitter, List of Test Points (Sheet 5 of 5)

### 8-23. SERVICING.

#### 8-24. RADIO RECEIVER-TRANSMITTER PRESSURIZATION.

8-25. To closed and pressurize the radio receiver-transmitter, proceed as follows:

- Wipe gasket and mating surfaces clean with a soft cloth moistened with any good, general purpose solvent. Assure that gasket and mating surfaces are not scored or deformed sufficiently to prevent an airtight closure.
- Apply a thin coat of Dow-Corning DC-4 compound or other Specification MIL-S-8660 equivalent, to both gasket faces and mating surfaces.
- Place gasket in position on chassis. Two or more matchsticks or other dowels may be used in screwholes to keep gasket from slipping.
- Place cover atop RT chassis and install all socket-head capscrews finger tight. Do not cross thread any screw.
- Using a properly calibrated torque wrench and complying with T.O. 32B14-3-1-101, carefully torque all capscrews to  $20 \pm 3$  inch-pounds.
- Using a source of clean, dry air, or dry nitrogen, pressurize the closed radio set to  $12 \pm 2$  PSIG.

g. Carefully plug both radio set cooling air ducts to a watertight condition. Correctly sized sink stoppers are often used - assure watertight closure.

h. Immerse radio set in water and look for bubbles which will denote a leak. Properly correct any leak that is discovered.

i. Upon final removal of radio from water immersion, carefully assure that any extraneous water in the cooling air ducts and heat exchanger is blown or dried out. Heat exchanger will corrode rapidly if water is allowed to stand in it.

j. Increase pressure to  $17.0 \pm 2$  PSIA. Measure resistance from 2J4-S to ground. Resistance shall be greater than 1 megohm.

k. Decrease pressure to  $15.75 \pm 0.5$  PSIA. Measure resistance from 2J4-S to ground. Resistance shall be less than 2 ohms.

l. Reduce radio set air pressure to  $6 \pm 1$  PSIG prior to placing radio in service or stock.

### 8-26. MODIFICATION HISTORY.

8-27. GENERAL. The following paragraph contains the modification history for the radio receiver-transmitter chassis and consists of changes that were made at manufacturing control number (MCN) 230.

Figure 8-7. Deleted.

8-28. The modification history is as follows:

- a. Diode 2CR1 (1N645) was from relay 2K2-11, now between relay 2K3-1 and 2K3-7.
- b. Circuit from jack 2J4-T was to relay 2K3-12, now to relay 2K2-12.
- c. Circuit from pressure switch 2S1-NC was to relay 2K3-12, now to relay 2K2-12.
- d. Circuit from relay 2K3-1 was to relay 2K2-11, now to relay 2K4-4.

- e. Circuit from relay 2K2-1 was to relay 2K4-4, now to relay 2K3-5.
- f. Circuit from relay 2K3-11 was to terminal board TB1-2, now to relay 2K5-1.
- g. Circuit from jack 2J32-16 was to relay 2K2-11, now to relay 2K3-11.
- h. Circuit from jack 2J21-25 was to relay 2K2-11, now to relay 2K3-11.
- i. Added circuit from relay 2K3-12 to ground.
- j. Change diode CR12 from 1N933 to JAN-1N914.



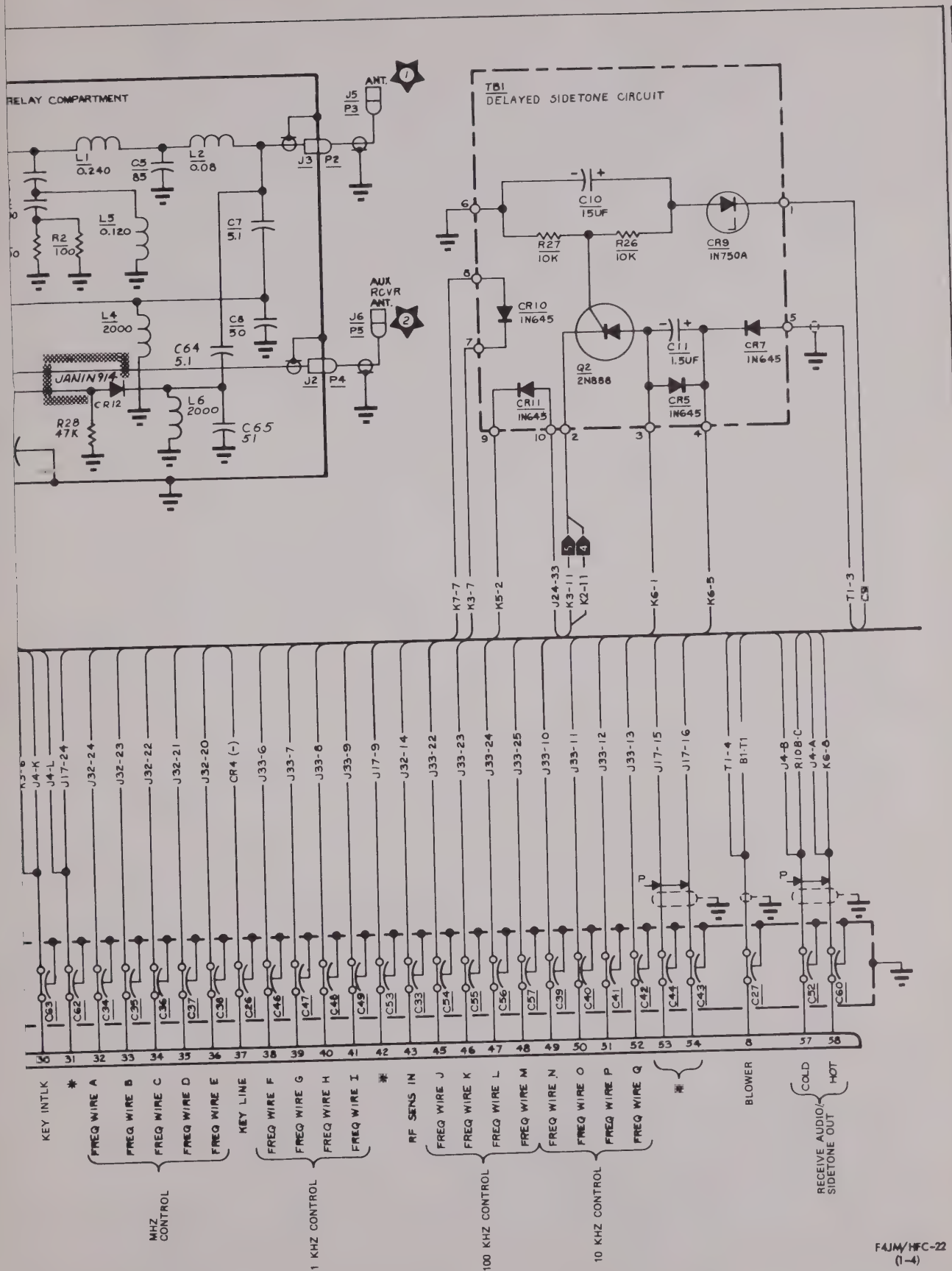


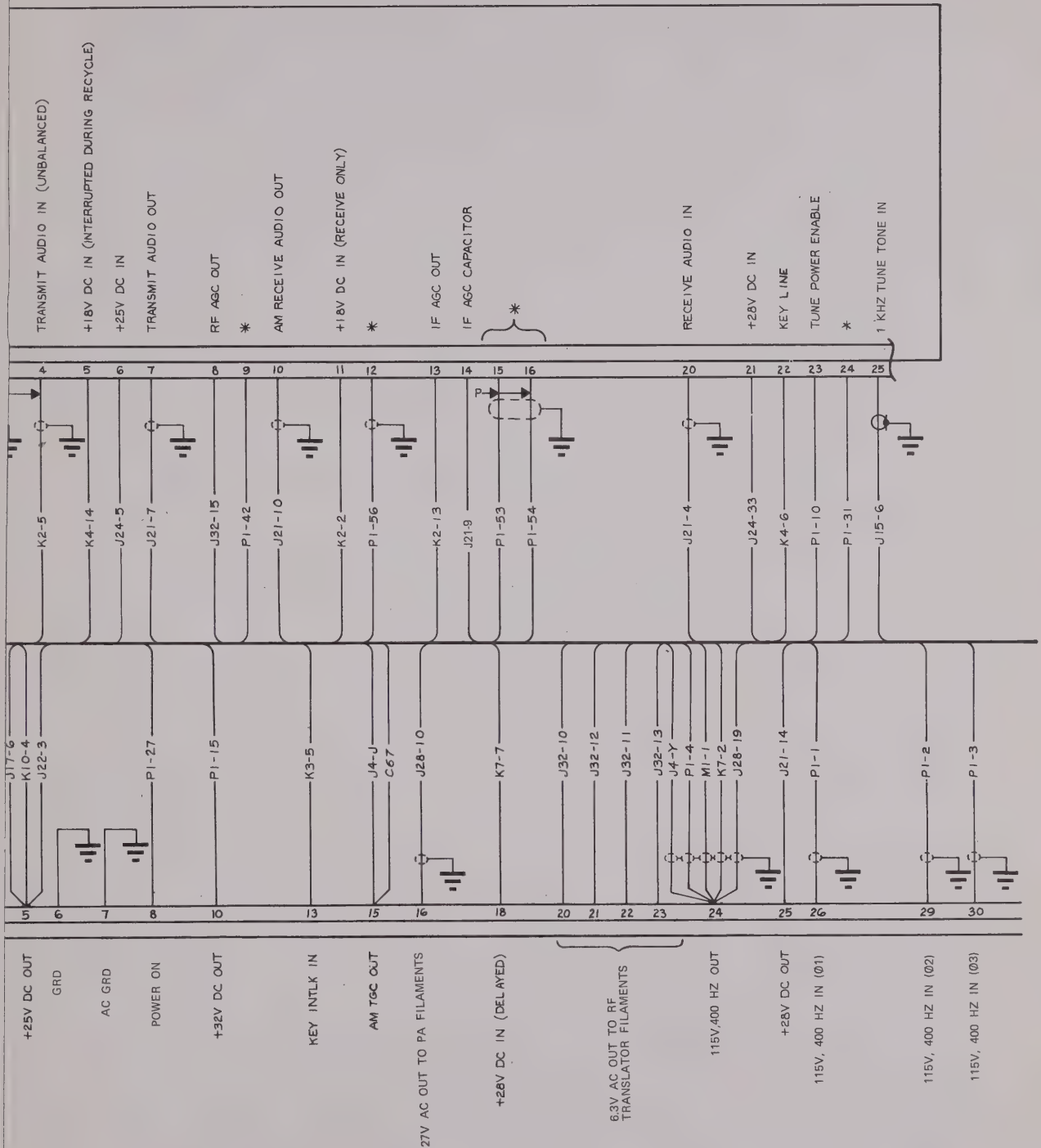
Figure 8-8. Radio Receiver-Transmitter Chassis,  
Schematic Diagram (Sheet 1 of 4)





Change 3 8-15/8-16

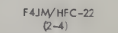




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(2-4)

Figure 8-8. Radio Receiver-Transmitter Chassis, Schematic Diagram (Sheet 2 of 4)





8-17/8-18







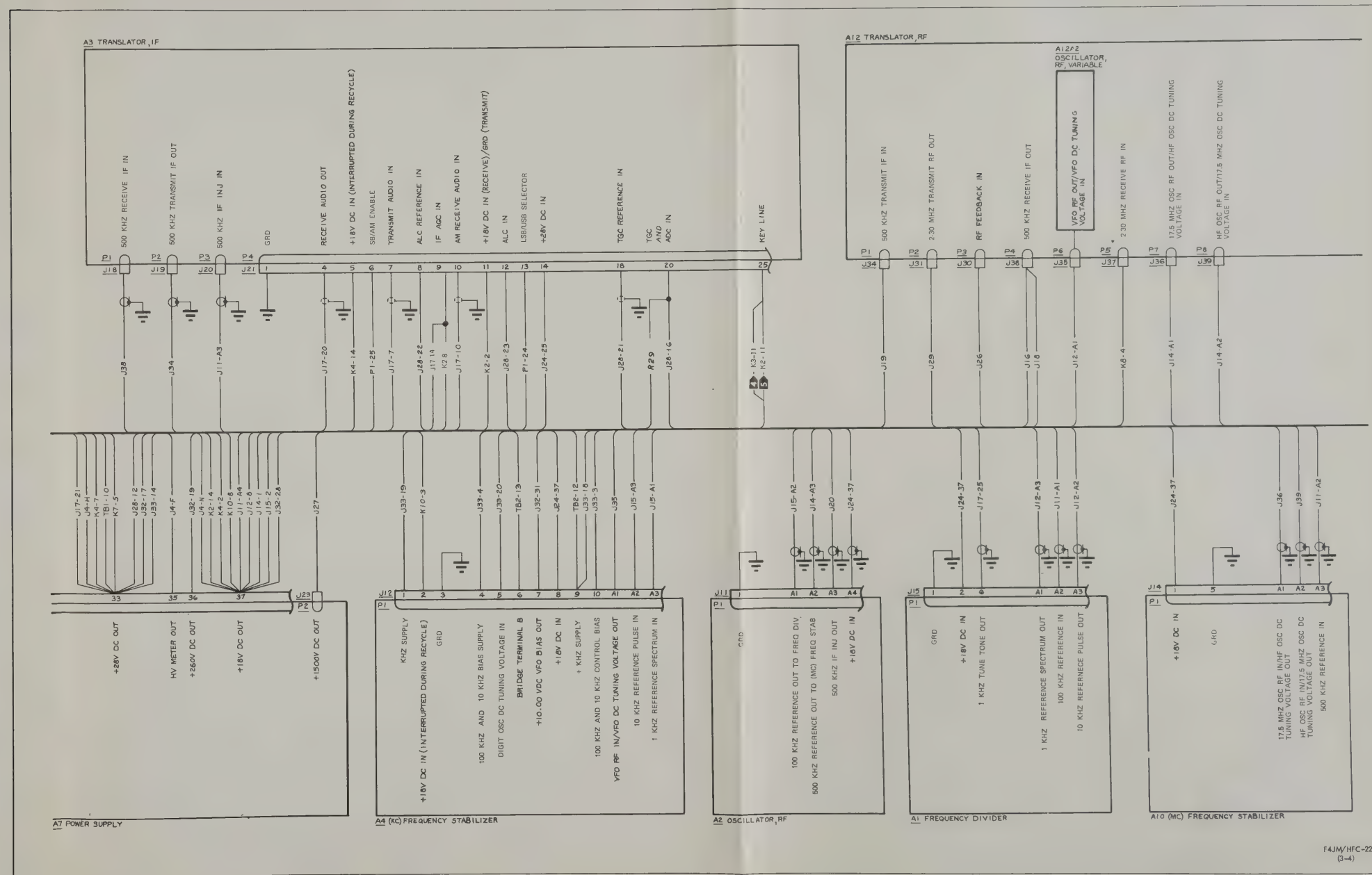


Figure 8-8. Radio Receiver-Transmitter Chassis, Schematic Diagram (Sheet 3 of 4)



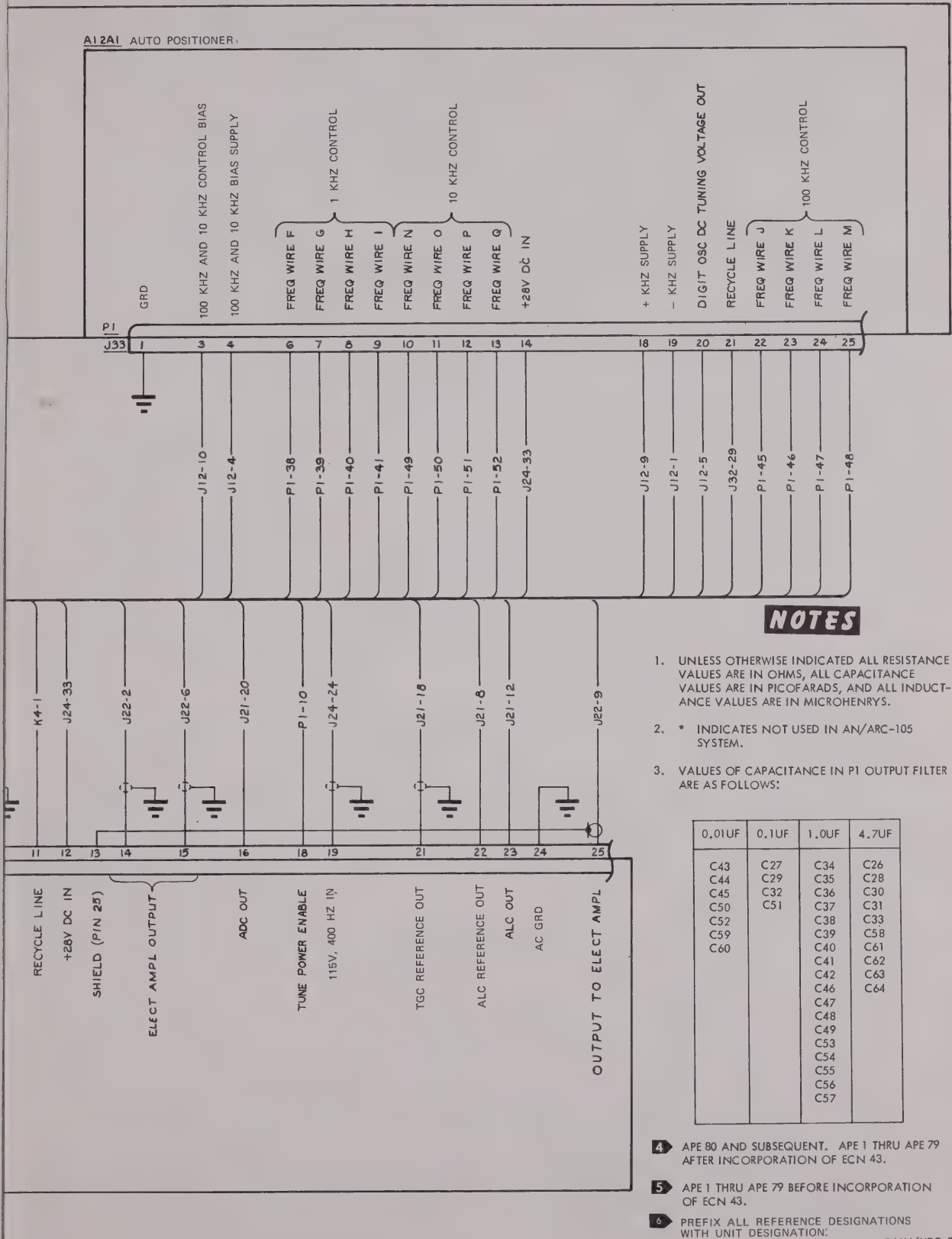


Figure 8-8. Radio Receiver-Transmitter Chassis, Schematic Diagram (Sheet 4 of 4)



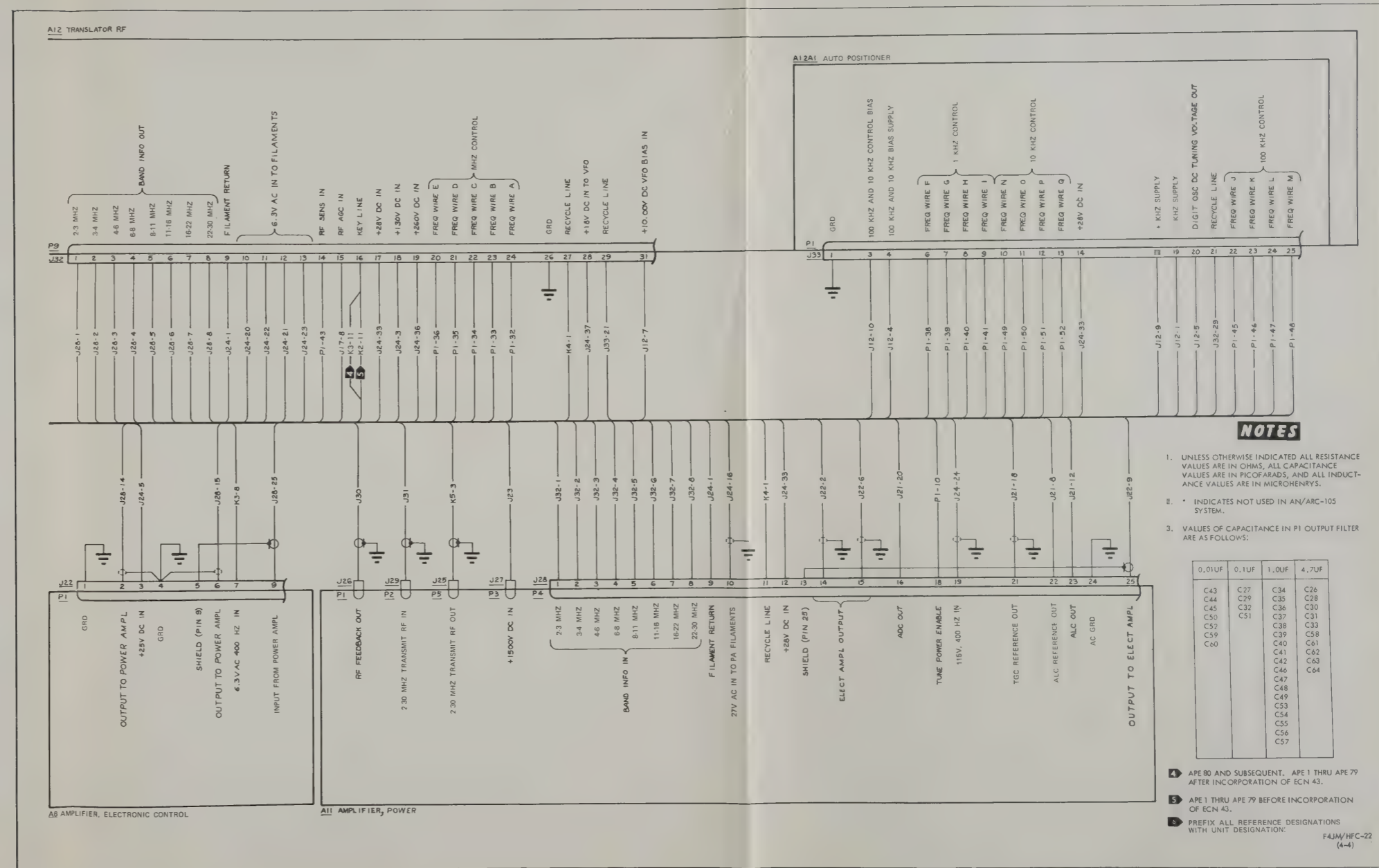


Figure 8-8. Radio Receiver-Transmitter Chassis, Schematic Diagram (Sheet 4 of 4)



Frequency Divider  
PN 0445-00  
MCN 912

A3  
A4

MCN 912

CIRCUIT ANALYSIS	8-30
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MODULE TEST PROCEDURE	8-44
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ASSEMBLY	8-52
MODIFICATION HISTORY	8-54

8-23

## 8-29. FREQUENCY DIVIDER 2A1.

### 8-30. CIRCUIT ANALYSIS.

8-31. GENERAL. Frequency divider 2A1 converts a 100-KHZ sine-wave input from RF oscillator 2A2 to a 10-KHZ pulse and a 1-KHZ frequency spectrum centered at 550 KHZ. These outputs are used for frequency stabilization in KC frequency stabilizer 2A4.

8-32. BLOCK DIAGRAM ANALYSIS. (Refer to figure 8-10.) The 100-KHZ input from RF oscillator 2A2 is applied through amplifier 2A1Q1 to the pulse generator consisting of transistors 2A1Q2 and 2A1Q3. The pulse generator amplifies and converts the 100-KHZ sinusoidal input to a 100-KHZ square wave. The square wave is amplified by pulse amplifier 2A1Q4 and applied to the 100-KHZ-10-KHZ divider made up of logic blocks 2A1A1 and 2A1A2. The divider output, a 10-KHZ pulse, is amplified by pulse amplifiers 2A1Q5 and 2A1Q6, and applied through emitter follower 2A1Q7 to KC frequency stabilizer 2A4 and pulse amplifier 2A1Q8.

8-33. The 10-KHZ pulse is amplified by pulse amplifier 2A1Q8 and divided by the 10-KHZ-1-KHZ divider to produce a 1-KHZ pulse. This pulse is amplified by pulse amplifier 2A1Q9 and applied to a monostable multivibrator (keyer, transistors 2A1Q10 and 2A1Q11). The keyer supplies a 1-KHZ tune tone and a 1-KHZ control pulse for keyed oscillator 2A1Q12. Keyed oscillator 2A1Q12 is tuned to have a free-running frequency of 550 KHZ. The 1-KHZ control pulse turns the keyed oscillator on and off at a 1-KHZ rate. The output of the keyed oscillator is a 1-KHZ spectrum centered at 550 KHZ.

8-34. DETAILED CIRCUIT ANALYSIS. (Refer to figure 8-13.) The 100-KHZ input is capacity coupled to amplifier 2A1Q1 from resistor 2A1R1 which provides a load for RF oscillator 2A2. This signal is amplified and applied to the pulse generator, a Schmitt trigger circuit, that consists of transistors 2A1Q2 and 2A1Q3. When the amplitude of the input signal reaches a predetermined level, transistor 2A1Q2 will conduct and cut off transistor 2A1Q3. When the amplitude of the input signal falls below this level, the reverse will occur. The output of the pulse generator is a 100-KHZ square wave. The square wave is amplified by pulse amplifier 2A1Q4 to a level sufficient to drive the gating circuits of the 100-KHZ-10-KHZ divider.

8-35. The 100-KHZ square-wave output of amplifier 2A1Q4 is applied to logic block 2A1A2, divided, and then applied to logic block 2A1A1. The output of logic block 2A1A1 is a 10-KHZ pulse.

8-36. The 10-KHZ pulse from logic block 2A1A1 is amplified by pulse amplifier 2A1Q5. The output of pulse amplifier 2A1Q5 is applied to pulse amplifier 2A1Q6 where it is further amplified and applied to emitter follower 2A1Q7. Emitter follower 2A1Q7

provides an impedance match between pulse amplifier 2A1Q6 and the 1-KHZ keyer in KC frequency stabilizer 2A4.

8-37. The second frequency division process is initiated by applying the 10-KHZ output of emitter follower 2A1Q7 to pulse amplifier 2A1Q8. Pulse amplifier 2A1Q8 amplifies the low-level output of emitter follower 2A1Q7 to a level sufficient to drive the gating circuits in the 10-KHZ-1-KHZ divider. Logic blocks 2A1A4 and 2A1A3 divide the 10-KHZ input signal by 10, producing one 1-KHZ output.

8-38. The 1-KHZ output from logic block 2A1A3 is amplified by pulse amplifier 2A1Q9 and used to trigger the keyer, a monostable multivibrator consisting of transistors 2A1Q10 and 2A1Q11. The keyer output turns keyed oscillator 2A1A12 on and off at a 1-KHZ rate. The free-running 550-KHZ frequency of the keyed oscillator is determined by the tuned circuit composed of capacitors 2A1C22, 2A1C23, and 2A1C26, and variable inductor 2A1L3. The output of the keyed oscillator is a 1-KHZ spectrum 546 to 555 KHZ centered at 550 KHZ. A 1-KHZ tune tone is also applied to AM/audio amplifier 2A9 during the tune cycle.

### 8-39. TEST PROCEDURES.

### 8-40. TEST SETUP.

8-41. Before interconnecting equipment, ensure that all primary power switches are placed in OFF position.

## WARNING

Before connecting the primary power cable to the bench, make sure that a ground strap is connected between the ground lug on the bench and the nearest ground point of the primary power source.

Interconnect test equipment as shown in figure 2-1. Deviations from the test equipment hookup diagram are covered in the test procedures. Test equipment required is listed in figure 3-1.

## NOTE

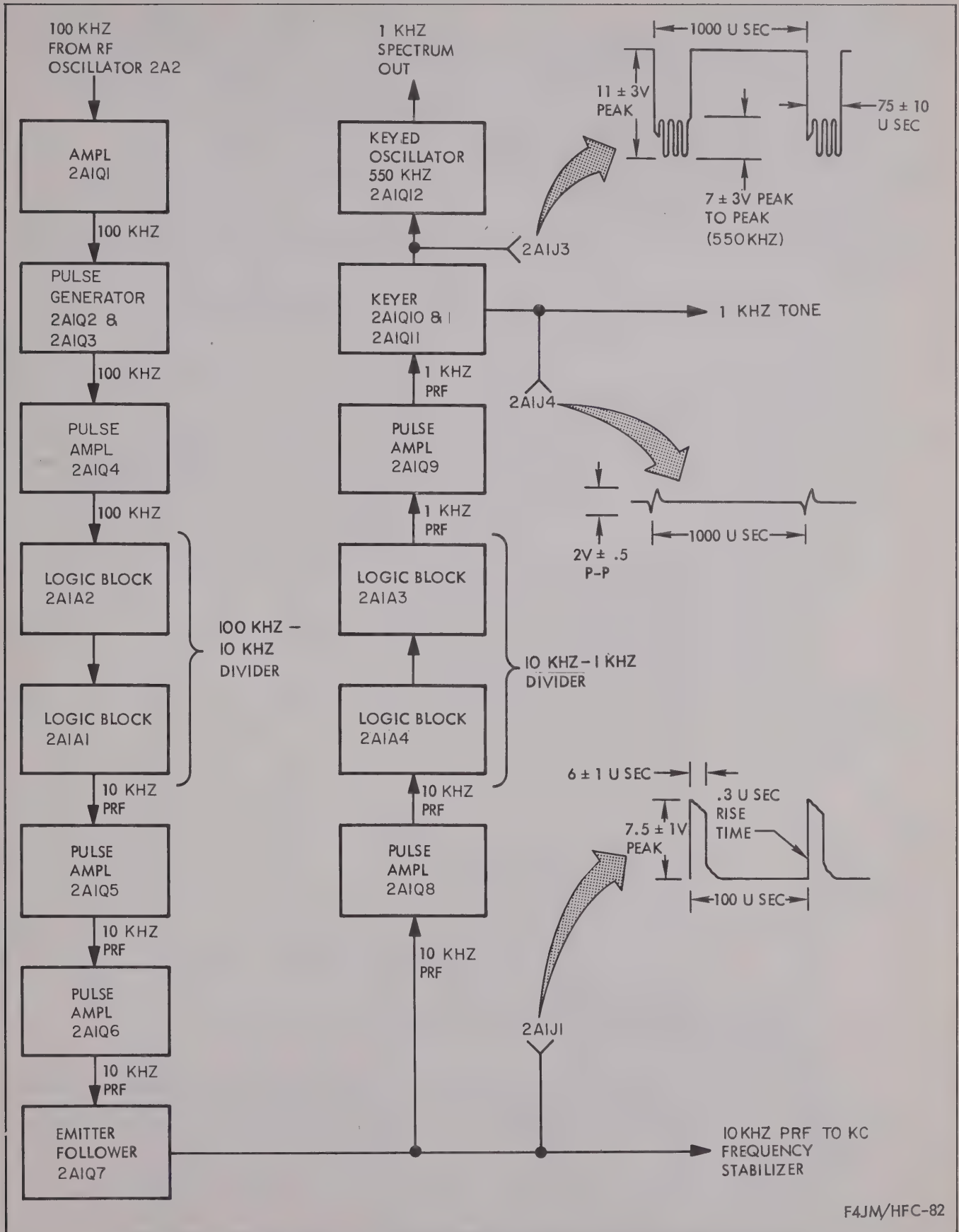
Equivalent test equipment may be used.

### 8-42. INITIAL CONTROL SETTINGS.

8-43. Refer to figure 6-8. Deviations from the initial control settings are covered in the test procedures.

### 8-44. MODULE TEST PROCEDURE.

8-45. Perform the test procedures of figure 8-11 in the order given.



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Figure 8-10. Frequency Divider 2A1, Block Diagram

8-46. TROUBLE ANALYSIS.

8-47. Trouble analysis information is incorporated in the PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY column of figure 8-11.

8-48. DISASSEMBLY.

8-49. Disassembly of frequency divider 2A1 is self-evident.

8-50. INSPECTION, CLEANING, AND REPAIR.

8-51. Inspection, cleaning, and repair information is contained in section X.

8-52. ASSEMBLY.

8-53. Assembly of frequency divider 2A1 is self-evident.

8-54. MODIFICATION HISTORY.

8-55. GENERAL. The following paragraph contains the modification history for frequency divider 2A1.

The history is arranged by MCN or configuration identifier (CI) effectivity. In some cases it was not necessary to record the MCN effectivity.

8-56. FREQUENCY DIVIDER 2A1. The modification history is as follows:

NOTE

Reference designations are abbreviated. Prefix designations with 2A1.

- a. Changed diode CR2 from 1N198 to JAN-1N933.
- b. Changed resistor R34 from 6190 to 10,000 ohms.
- c. At MCN 796, changed capacitor C9 from 120 to 150 picofarads.
- d. At MCN 1180, added diode CR3, JAN-1N933.
- e. Changed resistor R20 from 1K to test selected value.
- f. At CI 73095, added 8.2K resistor R44.
- g. At REV LTR J, changed Q12 from 2N2188 to 2N3135.
- h. At ECN 52, changed R43 from 220 to 100K.

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
1		Initial test requirements	<p>Refer to figure 8-12 for location of all test points on frequency divider 2A1.</p> <p>Remove frequency divider 2A1 from radio receiver-transmitter chassis, and perform visual inspection.</p> <p>Remove dust cover from module to perform this test procedure.</p> <p>Connect frequency divider 2A1 through module extender to radio receiver-transmitter chassis.</p> <p>NOTE</p> <p>Unless otherwise specified, all steps are performed with radio set control mode selector set to AM, no signal in, and radio receiver-transmitter unkeyed.</p> <p>Apply 115-volt, 400-HZ, 3-phase primary power to radio set test harness input power cable W20.</p> <p>Apply 115-volt, 60-HZ, single-phase primary power to HVU blower power cable.</p> <p>Position radio set test harness POWER switch to ON.</p>		
(Cont)				Radio set test harness POWER lamp should light, and radio receiver-transmitter blower should operate.	Repair or replace faulty POWER lamp and/or blower.

Figure 8-11. Frequency Divider 2A1, Module Checks and Adjustments (Sheet 1 of 4)

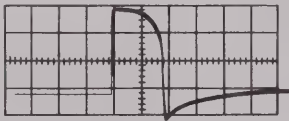
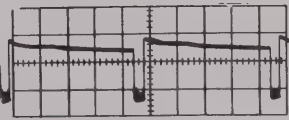
STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
1 (Cont)			<p>Position radio set control mode selector to AM.</p> <p>NOTE</p> <p>Allow 15 minutes for equipment to warm up.</p>	<p><b>CAUTION</b></p> <p>Position POWER switch to OFF immediately if blower does not operate.</p>	<p>NOTE</p> <p>Refer to Radio Set Test Bench AN/ARM-86 (TO 33D7-4-14-1) for repair procedures of faulty equipment contained in AN/ARM-86.</p>
2	2A1J2 (A2)	Transistor supply voltage check	<p>Connect HP-410B VTVM DC probe to test point (A2).</p> <p>Check voltage at test point (A2).</p>	+17 to +19 volts DC.	Check power supply 2A7.
3	2A1J1 (A1)	10-KHZ pulse	<p>Set oscilloscope for 2 V/CM, DC, 5.0 US/CM.</p> <p>Connect oscilloscope vertical input to test point (A1).</p> <p>Check waveform at test point (A1).</p>	 <p>6.5 to 8.5 volts peak to peak.</p>	<p>Check 2A1Q1 through 2A1Q7 and logic blocks 2A1A1 and 2A1A2 and associated circuits.</p> <p>NOTE</p> <p>Due to the interaction of the logic blocks, it is recommended that they be replaced as a pair.</p>
4  (Cont)	2A1J3 (A3)	Keyer output check	<p>Set oscilloscope for 5 V/CM, DC, 200 US/CM.</p> <p>Connect oscilloscope vertical input to test point (A3).</p> <p>Check waveform at test point (A3).</p>	 <p>8 to 15 volts peak to peak.</p>	<p>Logic blocks 2A1A3 and 2A1A4, 2A1Q9, 2A1Q10, 2A1Q11, and associated circuits.</p>

Figure 8-11. Frequency Divider 2A1, Module Checks and Adjustments (Sheet 2 of 4)

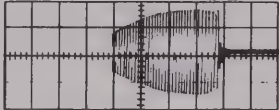
STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
4 (Cont)					NOTE  Due to the interaction of the logic blocks, it is recommended that they be replaced as a pair.
5	Collector of 2A1Q12 (A5)	Keyed oscillator output check	Set oscilloscope for 2 V/CM, 25 US/CM.  Connect oscilloscope vertical input to test point (A5).  Check waveform at test point (A5).	  6 to 12 volts peak to peak	Check 2A1Q2 and associated circuits. Replace faulty components as necessary.
6	2A4E5J8 (D8)	Keyed oscillator output adjustment	Install KC frequency stabilizer 2A4 on module extender.  Connect oscilloscope vertical input to test point (D8).  Adjust 2A1L3 and 2A1L4 to peak signal amplitude at test point (D8). Adjust for largest of several peaks.  Disconnect oscilloscope.  Turn off power.  Remove KC frequency stabilizer 2A4 from module extender.  Remove 2A4 module extender from radio receiver-transmitter chassis.  Replace dust cover on 2A4.  Replace 2A4 in radio receiver-transmitter chassis.		
7  (Cont)		Tune tone output level check	Turn on power.  Set oscilloscope for 0.5 V/CM, 500 US/CM.  Connect oscilloscope vertical input to TP6 on module extender.		

Figure 8-11. Frequency Divider 2A1, Module Checks and Adjustments (Sheet 3 of 4)

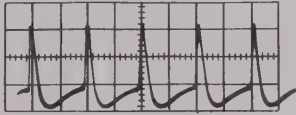
STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
7 (Cont)			Check waveform at TP6 on module	 <p>1.0 to 1.5 volts peak to peak.</p>	Logic blocks 2A1A3 and 2A1A4, 2A1Q9 and associated circuits. Replace faulty components as necessary.
8		Disconnect	<p>Turn off power.</p> <p>Disconnect all test equipment.</p> <p>Remove 2A1 from module extender.</p> <p>Remove module extender from radio receiver-transmitter chassis.</p> <p>Replace dust cover on 2A1.</p> <p>Replace 2A1 in radio receiver-transmitter chassis.</p>		

Figure 8-11. Frequency Divider 2A1, Module Checks and Adjustments (Sheet 4 of 4)

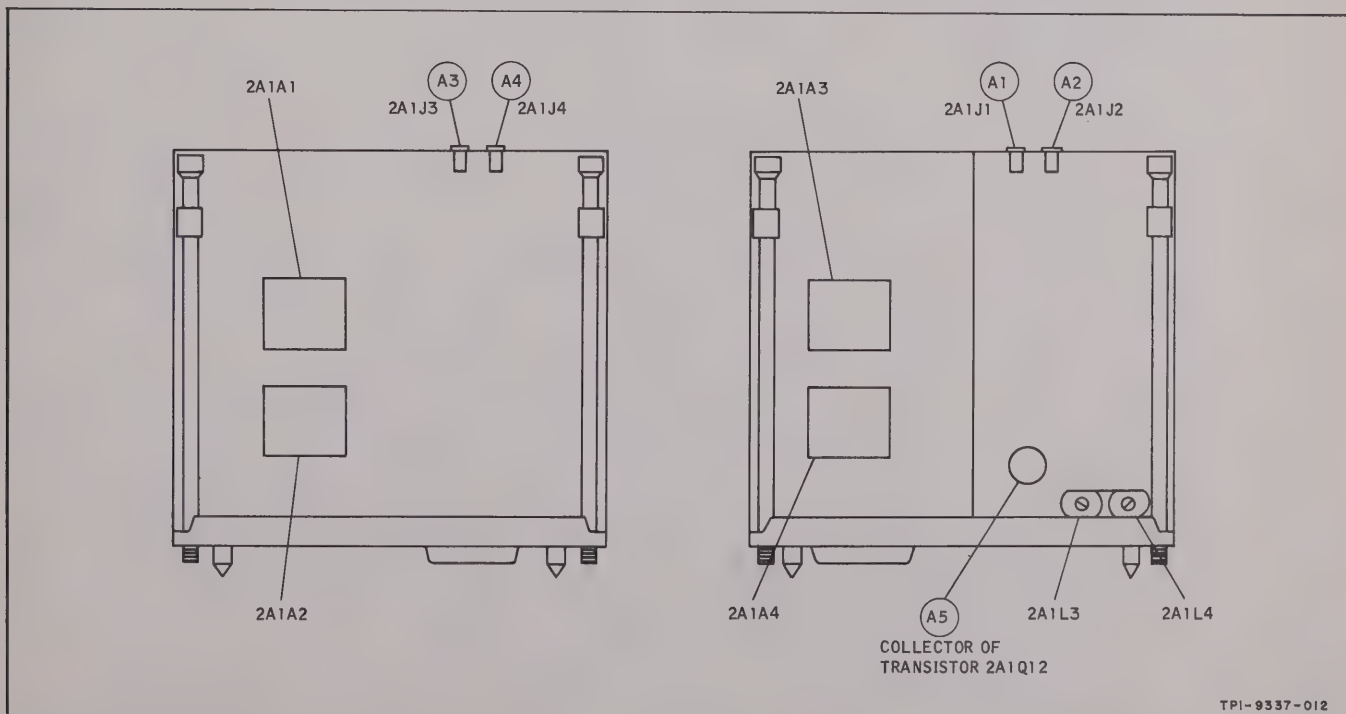


Figure 8-12. Frequency Divider 2A1, Test-Point and Component Location



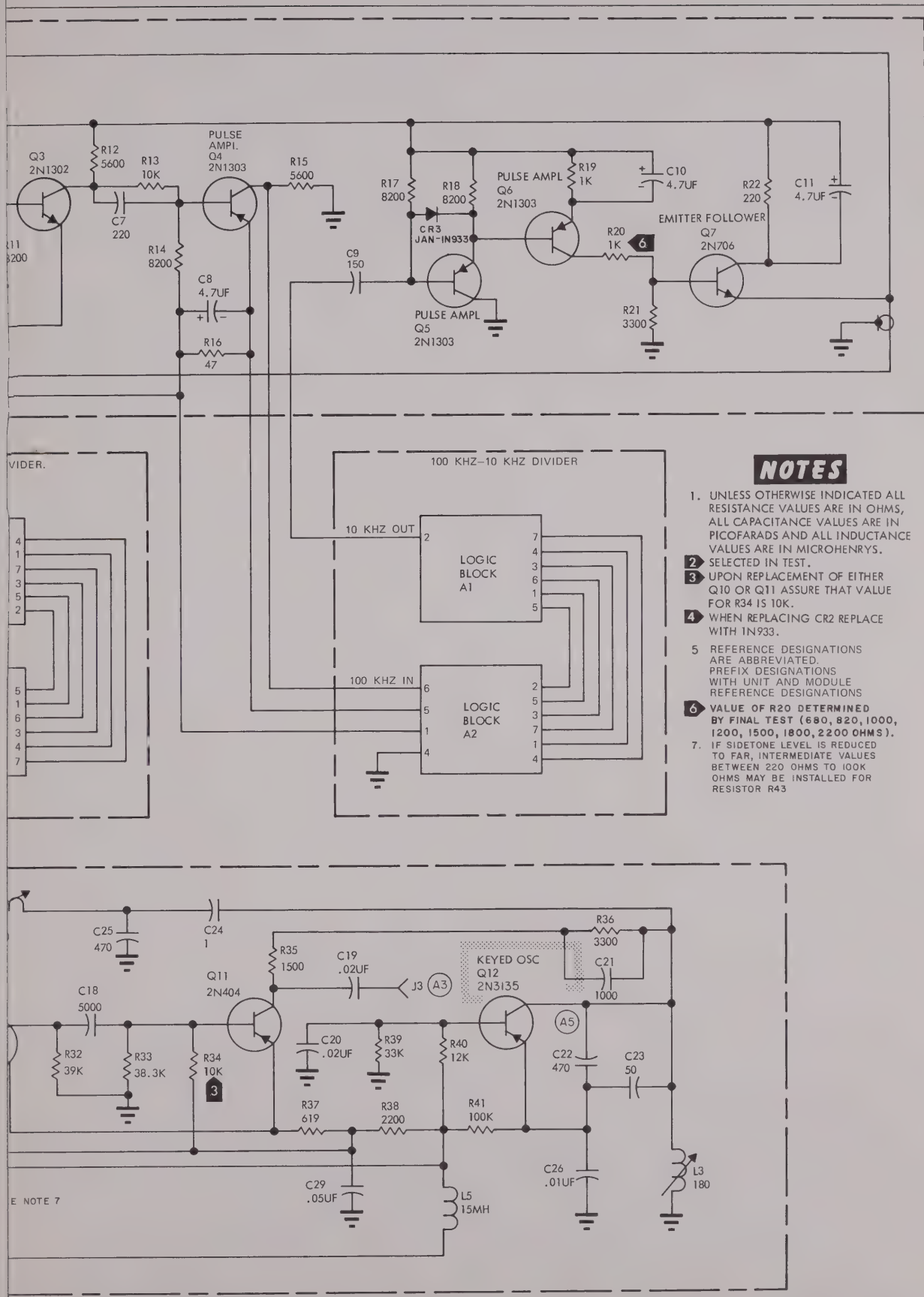


Figure 8-13. Frequency Divider 2A1, Schematic Diagram



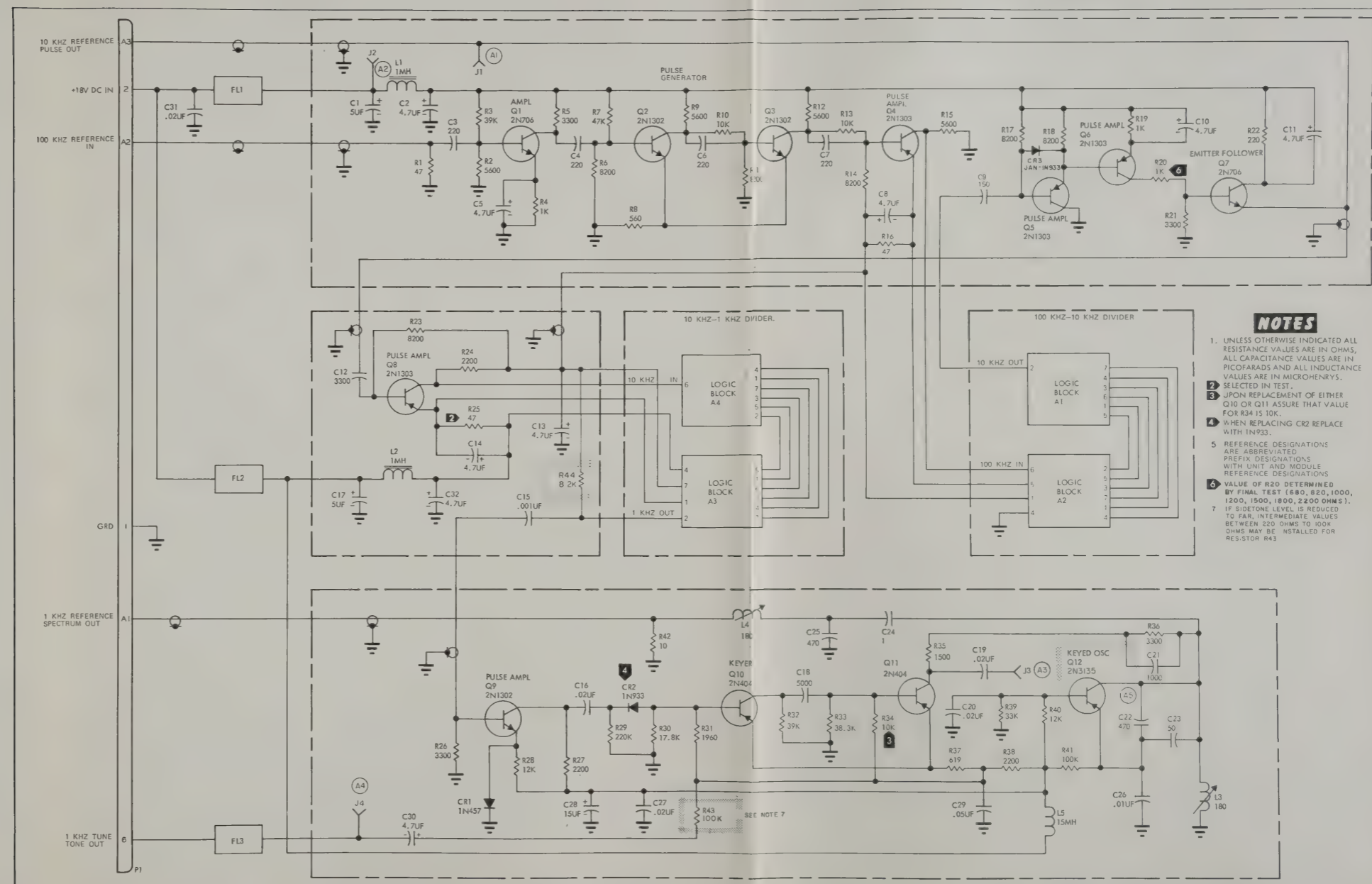


Figure 8-13. Frequency Divider 2A1, Schematic Diagram



**2A2**

**RF OSCILLATOR  
THEORY AND MAINTENANCE**



TPI-8802-017

**RF OSCILLATOR 2A2**

**Paragraph Number**

CIRCUIT ANALYSIS	8-58
TEST PROCEDURES	8-65
TEST SETUP	8-66
INITIAL CONTROL SETTINGS	8-68
MODULE TEST PROCEDURE	8-70
TROUBLE ANALYSIS	8-72
DISASSEMBLY	8-74
INSPECTION, CLEANING, AND REPAIR	8-77
ASSEMBLY	8-79
MODIFICATION HISTORY	8-82

Figure 8-14. RF Oscillator 2A2, Maintenance Marker

### 8-57. RF OSCILLATOR 2A2.

#### 8-58. CIRCUIT ANALYSIS.

8-59. GENERAL. RF oscillator 2A2 generates highly stable 100- and 500-KHZ output signals. The 100 KHZ output is applied to frequency divider 2A1 and the 500 KC outputs are applied to the MC frequency stabilizer 2A1Q and IF translator 2A3.

8-60. BLOCK DIAGRAM ANALYSIS. (Refer to figure 8-15.) The 3-MHZ signal generated by the temperature compensated crystal oscillator assembly is applied to locked oscillator 2A2Q4. The locked oscillator divides the 3-MHZ frequency by 6 to produce a 500-KHZ output. This 500-KHZ output is applied to 500-KHZ amplifier 2A2Q5 and to emitter follower 2A2Q7. The output of amplifier 2A2Q5 is applied to MC frequency stabilizer 2A10 and to 500-KHZ amplifier 2A2Q6. The output of amplifier 2A2Q6 is applied to IF translator 2A3.

8-61. Emitter follower 2A2Q7 isolates locked oscillator 2A2Q4 from the preceding circuit stages. The 500-KHZ signal from emitter-follower 2A2Q7 is applied to locked oscillator 2A2Q8. The oscillator divides the 500-KHZ signal by 5 and produces a 100-KHZ output signal. The output is amplified by

100-KHZ amplifier 2A2Q9 and applied to frequency divider 2A1.

8-62. DETAILED CIRCUIT ANALYSIS. (Refer to figure 8-18.) The temperature compensated crystal oscillator assembly corrects for the variations in frequency due to temperature changes of a quartz crystal. The output of the oscillator is applied to locked oscillator 2A2Q4. The frequency of the locked oscillator is controlled by a tuned circuit consisting of capacitors 2A2C13 through 2A2C16 and inductor 2A2L3. The circuit is tuned to one-sixth the crystal oscillator frequency, or 500-KHZ. The 500-KHZ output of locked oscillator 2A2Q4 is tapped from a voltage divider consisting of capacitors 2A2C15 and 2A2C16 and applied to the base of 500-KHZ amplifier 2A2Q5. Capacitors 2A2C15 and 2A2C16 also function as an impedance matching network. The output of locked oscillator 2A2Q4 is also applied to the base of emitter-follower 2A2Q7.

8-63. The 500-KHZ signal from locked oscillator 2A2Q4 is amplified by 500-KHZ amplifier 2A2Q5 and applied to jack J14A3 in MC frequency stabilizer 2A10. The output of 500-KHZ amplifier 2A2Q5 is also applied to 500-KHZ amplifier 2A2Q6 where it is further amplified and applied to jack 2A3J20.

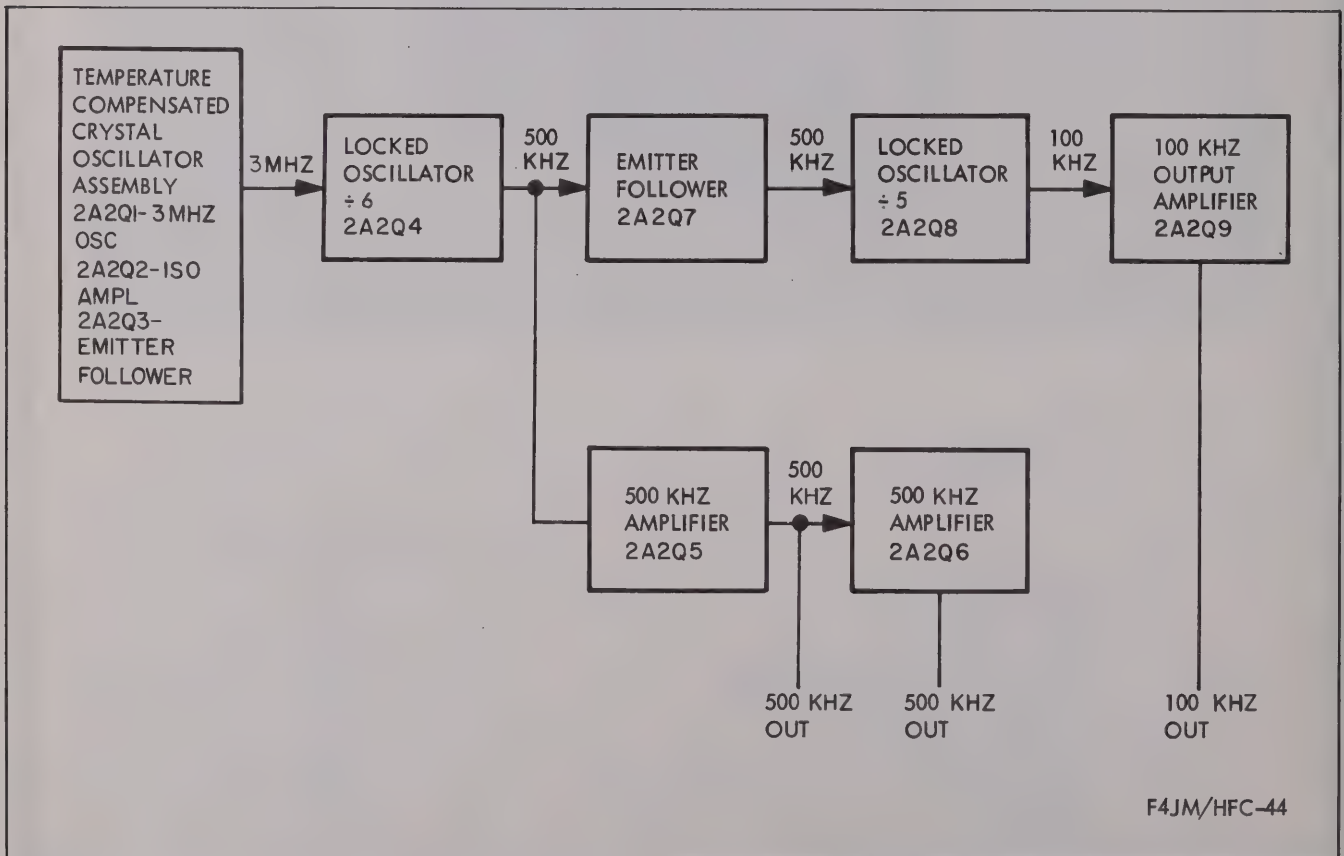


Figure 8-15. RF Oscillator 2A2, Block Diagram

8-64. The output of emitter-follower 2A2Q7 is applied to the base of locked oscillator 2A2Q8. Locked oscillator 2A2Q8 functions in the same manner as locked oscillator 2A2Q4. Oscillator 2A2Q8, however, is tuned to one-fifth the input frequency (500 KHZ) so that its output is 100 KHZ. The 100-KHZ signal is tapped from a voltage divider consisting of capacitors 2A2C29 and 2A2C31 and applied to the base of 100-KHZ amplifier 2A2Q9. The 100-KHZ signal is amplified and applied to jack J15A2 in frequency divider 2A1.

#### 8-65. TEST PROCEDURES.

#### 8-66. TEST SETUP.

8-67. Before interconnecting equipment, ensure that all primary power switches are placed in OFF position.

### WARNING

Before connecting the primary power cable to the bench, make sure that a ground strap is connected between the ground lug on the bench and the nearest ground point of the primary power source.

Interconnect test equipment as shown in figure 2-1. Deviations from the test equipment hookup diagram are covered in the test procedures. Test equipment required is listed in figure 3-1.

#### NOTE

Equivalent test equipment may be used.

#### 8-68. INITIAL CONTROL SETTINGS.

8-69. Refer to figure 6-8. Deviations from the initial control settings are covered in the test procedures.

#### 8-70. MODULE TEST PROCEDURE.

8-71. Perform the test procedures of figure 8-16 in the order given.

#### 8-72. TROUBLE ANALYSIS.

8-73. Trouble analysis information is incorporated in the PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY column of figure 8-16.

#### 8-74. DISASSEMBLY.

8-75. With the exception of removal of the temperature compensated crystal oscillator, disassembly of RF oscillator 2A2 is self-evident.

8-76. REMOVAL OF TEMPERATURE COMPENSATED CRYSTAL OSCILLATOR. To remove the temperature compensated crystal oscillator, proceed as follows:

- Remove RF oscillator 2A2 from radio receiver-transmitter chassis.
- Remove dust cover from module.
- Remove large foam protection plug from module chassis.
- Remove crystal oscillator board from foam protection plug.
- Unsolder three leads.

#### 8-77. INSPECTION, CLEANING, AND REPAIR.

8-78. Inspection, cleaning, and repair information is contained in section X.

#### 8-79. ASSEMBLY.

8-80. With the exception of replacement of the temperature compensated crystal oscillator, assembly of RF oscillator 2A2 is self-evident.

8-81. REPLACEMENT OF TEMPERATURE COMPENSATED CRYSTAL OSCILLATOR. To replace the temperature compensated crystal oscillator, reverse the procedure of paragraph 8-76.

#### 8-82. MODIFICATION HISTORY.

8-83. GENERAL. The following paragraph contains the modification history for RF oscillator 2A2.

8-84. RF OSCILLATOR 2A2. The modification history is as follows:

#### NOTE

Reference designations are abbreviated. Prefix designations with 2A2.

- Replaced circuit from transistor Q7 (base) to resistor R35 with resistor R48 (100 ohms).
- Changed capacitors C15, C16, C21, and C26 from 5000 to 4700 picofarads.
- Changed capacitor C22 from 0.05 to 0.047 microfarad.
- Changed capacitors C23, C30, and C31 from 0.02 to 0.022 microfarad.
- Changed resistor R25 from 4700 ohms to test selected value.
- At REV LTR AK, changed capacitor C13 from 510 picofarads to test select value.

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
1		Initial test requirements	<p>Refer to figure 8-17 for location of all test points on RF oscillator 2A2.</p> <p>Remove RF oscillator 2A2 from radio receiver-transmitter chassis, and perform visual inspection.</p> <p>Remove dust cover from module to perform this test procedure.</p> <p>Connect RF oscillator 2A2 through module extender to radio receiver-transmitter chassis.</p> <p>NOTE</p> <p>Unless otherwise specified, all steps are performed with radio set control mode selector set to AM, no signal in, and radio receiver-transmitter unkeyed.</p> <p>Apply 115-volt, 400-HZ, 3-phase primary power to radio set test harness input power cable W20.</p> <p>Apply 115-volt, 60-HZ, single-phase primary power to HVU blower power cable.</p> <p>Position radio set test harness POWER switch to ON.</p> <p>NOTE</p> <p>Position radio set control mode selector to AM.</p> <p>NOTE</p> <p>Allow 15 minutes for equipment to warm up.</p>	<p>Radio set test harness POWER lamp should light, and radio receiver-transmitter blower should operate.</p> <p><b>CAUTION</b></p> <p>Position POWER switch to OFF immediately if blower does not operate.</p>	<p>Repair or replace faulty POWER lamp and/or blower.</p> <p>NOTE</p> <p>Refer to Radio Set Test Bench AN/ARM-86 TO 33D7-4-14-1) for repair procedures of faulty equipment contained in AN/ARM-86.</p>
2	2A2J2 B2	Transistor supply voltage check	<p>Connect HP-410B VTVM DC probe to test point B2.</p> <p>Check voltage at test point B2.</p>	+15 to +17 VDC.	Check power supply 2A7.

Figure 8-16. RF Oscillator 2A2, Module Checks and Adjustments (Sheet 1 of 5)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
3	2A2J1 (B1)	100-KHZ reference output check	<p>Connect a type 340 voltmeter to test point (B1).</p> <p>Check voltage at test point (B1).</p> <p>Connect frequency counter to test point (B1).</p> <p>Check frequency at test point (B1).</p>	<p>Not less than 0.4 VRMS.</p> <p>100 KHZ <math>\pm 0.1</math> HZ.</p>	Check mixer 2A2Q9 and associated circuit.
4	2A2J3 (B3)	500-KHZ reference output to MC frequency stabilizer 2A10 check	<p>Connect a type 340 voltmeter to test point (B3).</p> <p>Check voltage at test point (B3).</p> <p>Connect frequency counter to test point (B3).</p> <p>Check frequency at test point (B3).</p>	<p>0.9 to 1.3 VRMS.</p> <p>500 KHZ <math>\pm 0.4</math> HZ.</p>	Check 2A2Q4, 2A2Q5, and associated circuits.
5	2A2J4 (B4)	500-KHZ carrier output to balanced modulator check	<p>Connect a type 340 voltmeter to test point (B4).</p> <p>Check voltage at test point (B4).</p> <p>Connect frequency counter to test point (B4).</p> <p>Check frequency at test point (B4).</p>	<p>1.5 to 1.9 VRMS.</p> <p>500 KHZ <math>\pm 0.4</math> HZ.</p>	Check 2A2Q4, 2A2Q5, 2A2Q6, and associated circuits.
6	<p>Junction of 2A2C40 and 2A2C38 (B5)</p> <p>Junction of 2A2Q4 and 2A2R24 (B6)</p>	3-MHZ oscillator board test	<p>Connect HP-410B VTVM DC probe to test point (B5).</p> <p>Check voltage at test point (B5).</p> <p>Connect frequency counter to test point (B6).</p> <p>Check frequency at test point (B6).</p> <p>Connect a type 340 voltmeter to test point (B6).</p>	<p>+17.0 to 17.2 VDC.</p> <p>3.0 MHZ <math>\pm 2</math> HZ.</p>	<p>Check A2FL1, A2L10, or A2C40, and replace if necessary. +18-VDC output of power supply 2A7.</p> <p>Adjust capacitor 2A2C1.</p>
(Cont)					

Figure 8-16. RF Oscillator 2A2, Module Checks and Adjustments (Sheet 2 of 5)

Figure 8-16. RF Oscillator 2A2, Module Checks and Adjustments (Sheet 3 of 5)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
7 (Cont)					NOTE  Select values are listed in illustrated parts breakdown (TO 12R2-2ARC105-14).
	2A2J3 (B3)		Connect a type 340 voltmeter to test point (B3).  Check voltage at test point (B3).	1.0 to 1.2 VRMS.	Select value of 2A2C20 that peaks the voltage at test point 2A2J3, then select value of 2A2R44 that provides required results.
	2A2J4 (B4)		Connect a type 340 voltmeter to test point (B4).  Check voltage at test point (B4).	1.5 to 1.9 VRMS.	Check 2A2Q6 and associated circuit. Repair or replace faulty components as necessary.  Select value of 2A2C25 that peaks the voltage at test point (B4), then select value of 2A2R30 that provides required results.
	Junction of 2A2R24 and 2A2Q4 (B6)		Disconnect signal generator, attenuator, and capacitor from test point (B6). Do not resolder coaxial cable to test point (B6).		
	Junction of 2A2R34 and 2A2Q7 (B7)		Unsolder coaxial cable at test point (B7).  Connect signal generator through 6-DB attenuator and a 1000-PF capacitor to test point (B7).  Connect oscilloscope vertical input to test point (B7).		
(Cont)					

Figure 8-16. RF Oscillator 2A2, Module Checks and Adjustments (Sheet 4 of 5)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
7 (Cont)	2A2J1 (B1)		<p>Connect oscilloscope horizontal input to test point (B1).</p> <p>Set signal generator output to 500 KHZ, 0.5 VRMS (as indicated on frequency counter).</p> <p>Check pattern on oscilloscope.</p>	<p>5-to-1 Lissajous pattern.</p> <p>NOTE</p> <p>Pattern must remain stable; no phase changes or fuzziness.</p>	<p>Check 2A2Q7, 2A2Q8, 2A2Q9, and associated circuits. Repair or replace faulty component as necessary. Select value of 2A2C29 that will provide required results.</p>
8	<p>Junction of 2A2Q2 and 2A2R24 (B6)</p> <p>Junction of 2A2R34 and 2A2Q7 (B7)</p>	Disconnect	<p>Turn off power.</p> <p>Disconnect all test equipment.</p> <p>Resolder coaxial cable to test point (B6).</p> <p>Resolder coaxial cable to test point (B7).</p> <p>Remove RF oscillator 2A2 from module extender.</p> <p>Remove module extender from radio receiver-transmitter chassis, replace dust cover on module, and install module in radio receiver-transmitter chassis.</p>		

Figure 8-16. RF Oscillator 2A2, Module Checks and Adjustments (Sheet 5 of 5)

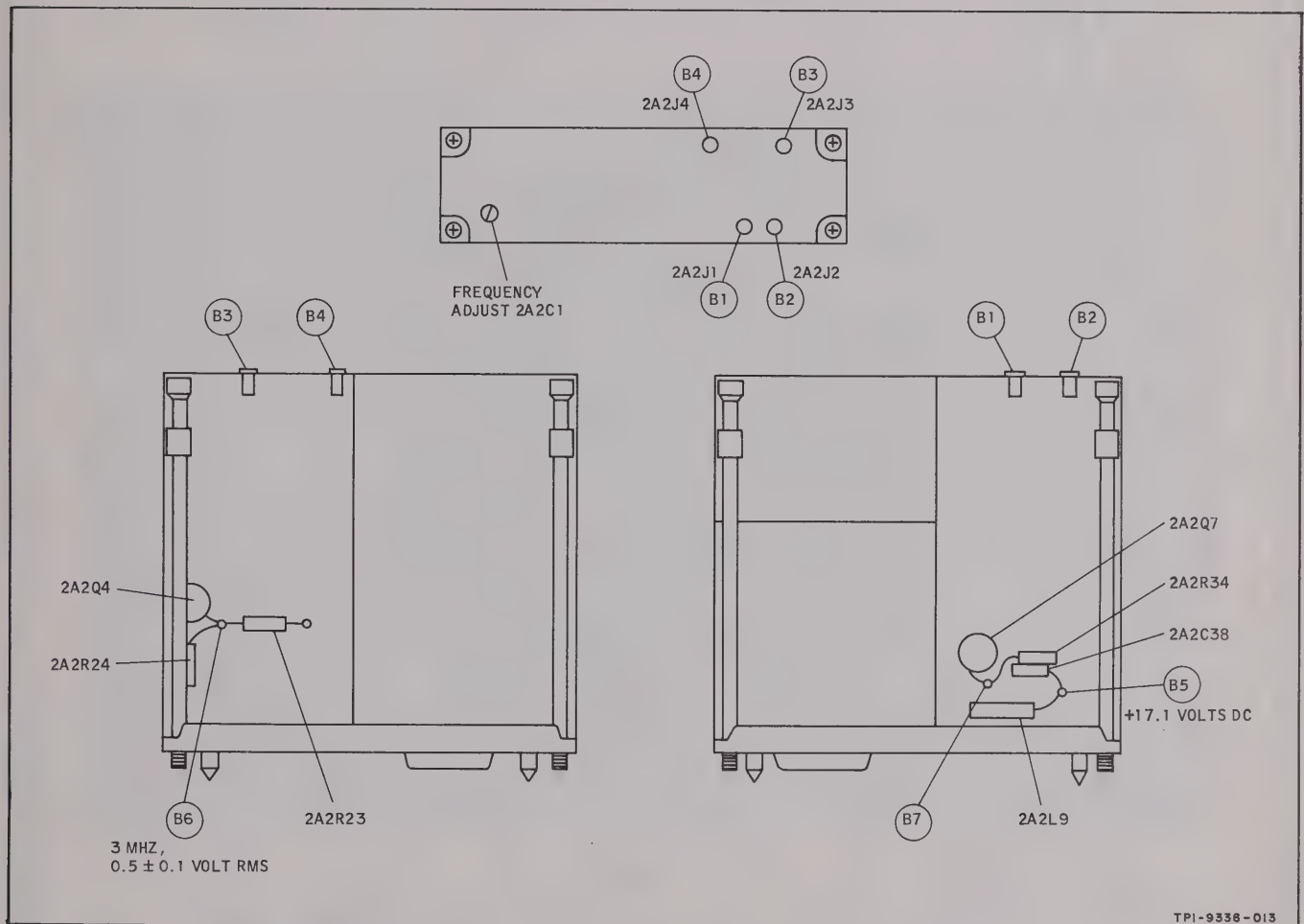


Figure 8-17. RF Oscillator 2A2, Test-Point and Component Location

# NOTES

1. VALUES DETERMINED IN FINAL PRODUCTION.
2. UNLESS OTHERWISE INDICATED ALL RESISTANCE VALUES ARE IN OHMS, ALL CAPACITANCE VALUES ARE IN PICOFARADS AND ALL INDUCTANCE VALUES ARE IN MICROHENRYS.
3. WHEN REPLACING L8 REPLACE WITH 1.1MH.
4. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX DESIGNATIONS WITH UNIT AND MODULE DESIGNATION.

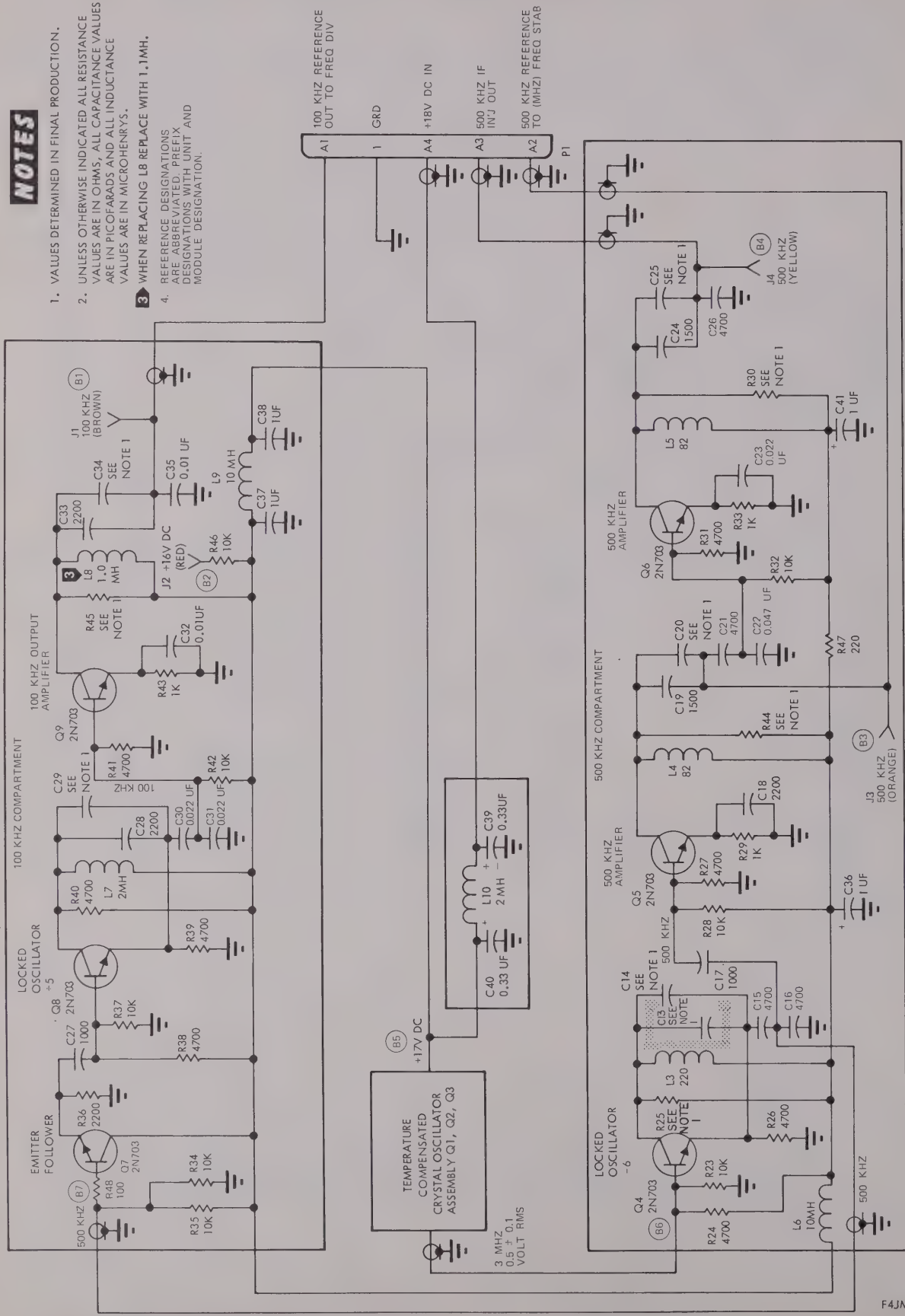
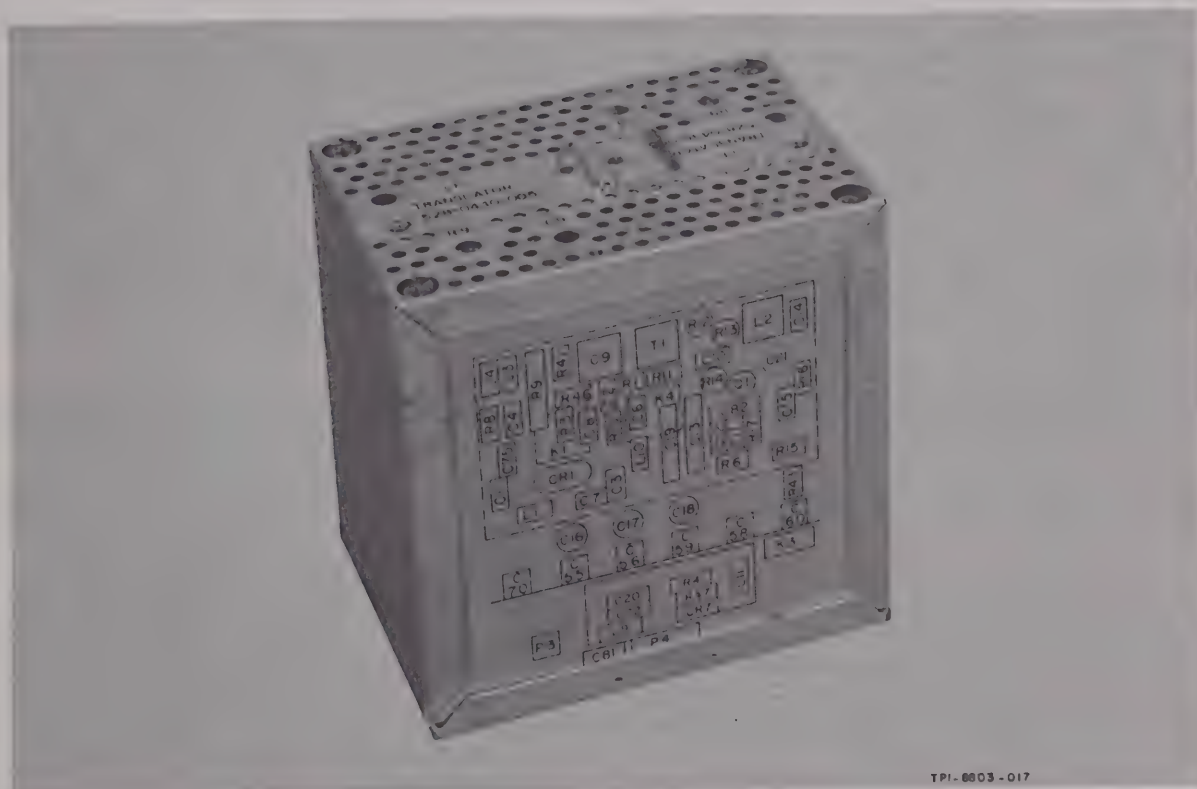


Figure 8-18. RF Oscillator 2A2, Schematic Diagram

**2A3**  
**IF TRANSLATOR**  
**THEORY AND MAINTENANCE**



**IF TRANSLATOR 2A3**

	Paragraph Number
CIRCUIT ANALYSIS	8-86
TEST PROCEDURES	8-97
TEST SETUP	8-98
INITIAL CONTROL SETTINGS	8-100
MODULE TEST PROCEDURE	8-102
TROUBLE ANALYSIS	8-104
DISASSEMBLY	8-106
INSPECTION, CLEANING, AND REPAIR	8-108
ASSEMBLY	8-110
MODIFICATION HISTORY	8-112

Figure 8-19. IF Translator 2A3, Maintenance Marker

## 8-85. IF TRANSLATOR 2A3.

### 8-86. CIRCUIT ANALYSIS.

8-87. GENERAL. IF translator 2A3 functions in both the transmit and receive mode. In the transmit mode, it generates a 500-KHZ SSB or AM signal. IF translator 2A3 contains SSB IF amplifiers and a product detector which functions in the receive mode.

8-88. BLOCK DIAGRAM ANALYSIS. (Refer to figure 8-20.) When the transceiver is in the transmit mode, the amplified audio signal from AM/audio amplifier 2A9 is combined with a 500-KHZ signal from RF oscillator 2A2 in balanced modulator 2A3CR1. The balanced modulator output signal is fed through transformer 2A3T1 to automatic load control amplifier 2A3Q1. The output of 2A3Q1 is further amplified by IF amplifier 2A3Q2, and fed to sideband relay 2A3K2. This relay, controlled by the mode selector on the radio set control, switches the double sideband so that it passes either through upper sideband filter 2A3FL1 or lower sideband filter 2A3FL2. When the mode selector is set to AM, the upper sideband filter is used, and a 500-KHZ carrier frequency is reinserted at the filter output. The filter output passes through relay 2A3K5 and is amplified by IF amplifier 2A3Q4. During transmit, IF amplifier 2A3Q3 is not required and is bypassed by relay 2A3K5. Stage 2A3Q4 is the transmitter gain control and automatic drive control stage. The gain of transmitter gain control stage 2A3Q4 is controlled by the output of DC amplifier 2A3Q6.

8-89. When the transceiver is in the receive mode, the 500-KHZ IF SSB signal from RF translator 2A12 is fed through IF amplifier 2A3Q2 to the sideband mechanical filters. The filter that passes the sideband being received is switched into the circuit by the radio set control. The filter output is further amplified by IF amplifiers 2A3Q3, 2A3Q4, and 2A3Q5, and then applied to the product detector. Relay 2A3K5 disconnects the ALC amplifier output from the IF amplifiers when in the receive mode.

8-90. DETAILED CIRCUIT ANALYSIS. (Refer to figures 8-21 and 8-26.) Balanced modulator 2A3CR1 is a diode chopper that translates the audio signal into a USB and LSB signal at a 500-KHZ rate. The 500-KHZ voltage switches the diodes on and off so that the audio input follows circuits as shown in (A) and (B), on successive half-cycles. The 500-KHZ switching voltage magnitude is approximately 10 times that of the audio, so that audio voltage peaks do not switch the diodes.

8-91. The switching action of the diodes causes equal 500-KHZ currents to flow in opposite directions through the primary winding of transformer 2A3T1. The sum of the equal, opposite currents in the winding is zero. The 500-KHZ carrier component is balanced

out of the modulator output. The diodes in the modulator circuit are matched. The forward resistances of the diodes in the two biased-on conditions, (A) and (B), are equal. Resistor 2A3R9 and capacitor 2A3C9 are adjustable so that the currents can be balanced even more closely. Thus the currents flowing through the diodes on successive half-cycles are equal. Capacitors 2A3C6 and 2A3C9 overcome the effects of distributed capacitance in the modulator circuit. The balanced modulator output with a single-tone audio input signal is shown in (D).

8-92. (Refer to figure 8-22.) Resistor 2A11R1 is common to the grid circuit of the power amplifiers and the emitter-base circuit of automatic load control amplifier 2A3Q1. When the grids of the power amplifier are overdriven, grid current flows through resistor 2A11R1. The voltage drop across resistor 2A11R1 reduces the emitter current in the automatic load control amplifier. This condition decreases the amplifier gain and reduces the drive to the power amplifier. The power amplifier grid drive is kept at its maximum possible level without grid current flowing. Capacitor 2A3C13, across resistor 2A11R1, provides fast attack, slow release action for the automatic load control circuit.

8-93. (Refer to figure 8-23.) The gain of transmitter gain control 2A3Q4 is controlled by the output of DC amplifier 2A3Q6. Amplifier 2A3Q6 has two inputs, one of which is from power supply 2A7. This negative voltage is proportional to the power amplifier plate current. The second input to DC amplifier 2A3Q6, from power amplifier 2A11, is proportional to the power amplifier RF plate voltage swing. The level of this signal is adjusted so that there is an input signal only if the RF plate voltage swing is excessive because the transmitter output is open circuited. If the power amplifier plate current tends to increase, or the RF plate voltage swing exceeds a preset value, the forward emitter-base voltage of transmitter gain control automatic drive control amplifier 2A3Q6 is decreased, causing the collector current to decrease. This collector current flows through resistors which are common to the collector circuit of transmitter gain control amplifier 2A3Q6 and the emitter-base circuit of IF amplifier 2A3Q4. When the collector current decreases in amplifier 2A3Q6, the base voltage of 2A3Q4 becomes more positive, thus decreasing the forward emitter-base voltage of 2A3Q4. This reduces the emitter current in IF amplifier 2A3Q4, and its gain. This feedback action keeps the power amplifier plate current and RF plate voltage swing from exceeding certain preset values. Transmitter gain control reference adjust 2A11R5 controls the transmitter power output. This output is adjusted for approximately 125 watts into a 52-ohm load in the AM mode.

8-94. A protective circuit in IF translator 2A3 is used to prevent overdriving the transmitter before its gain control circuits are stabilized. An RC circuit, consisting of capacitor 2A3C54 and resistor 2A3R39,

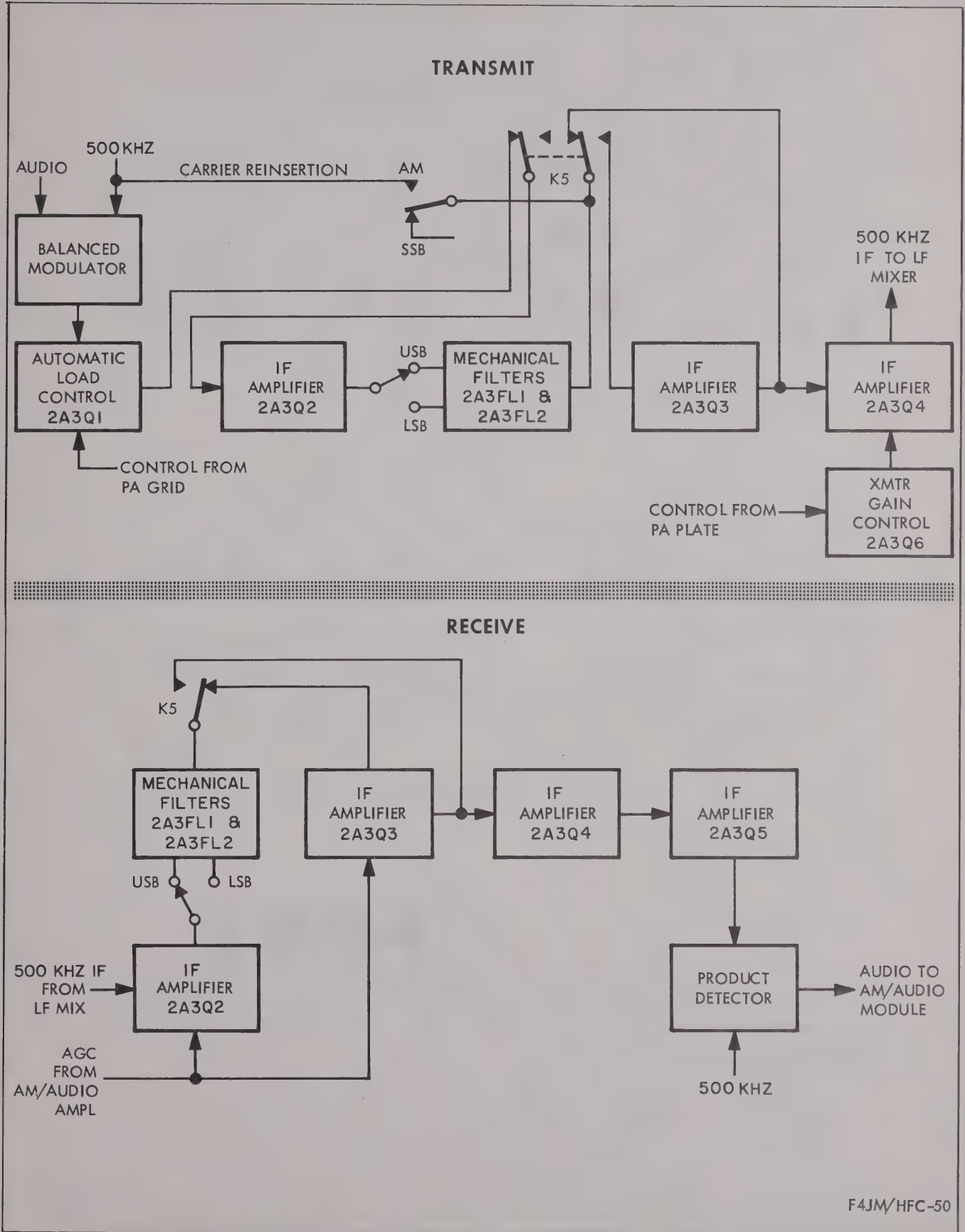
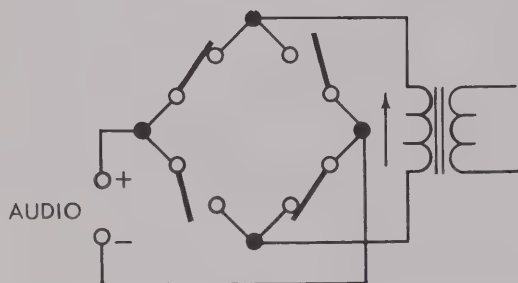
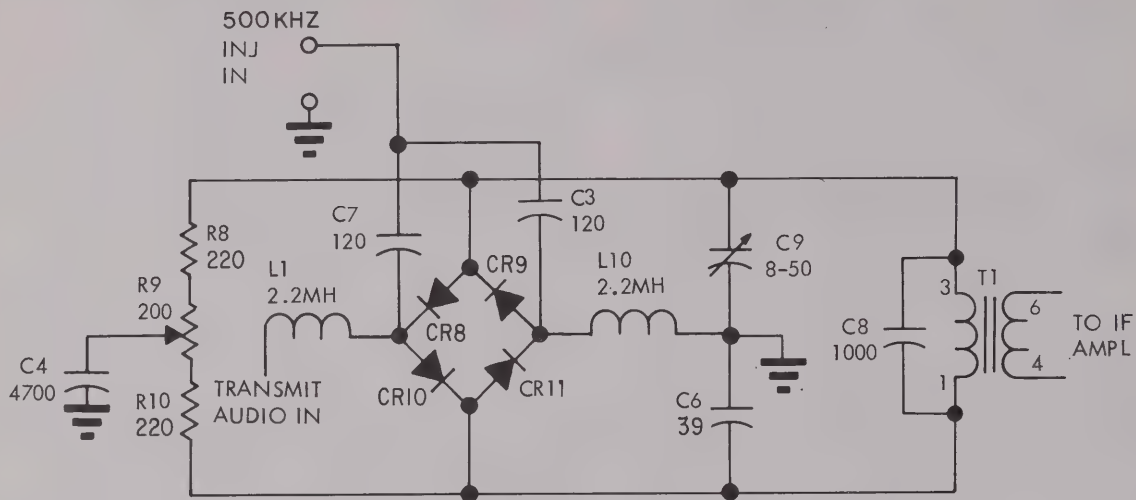
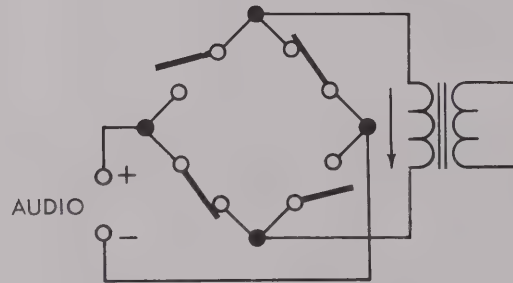


Figure 8-20. IF Translator 2A3, Block Diagram

(A) POSITIVE 1/2 CYCLES  
OF RF SWITCHING(B) NEGATIVE 1/2 CYCLES  
OF RF SWITCHING

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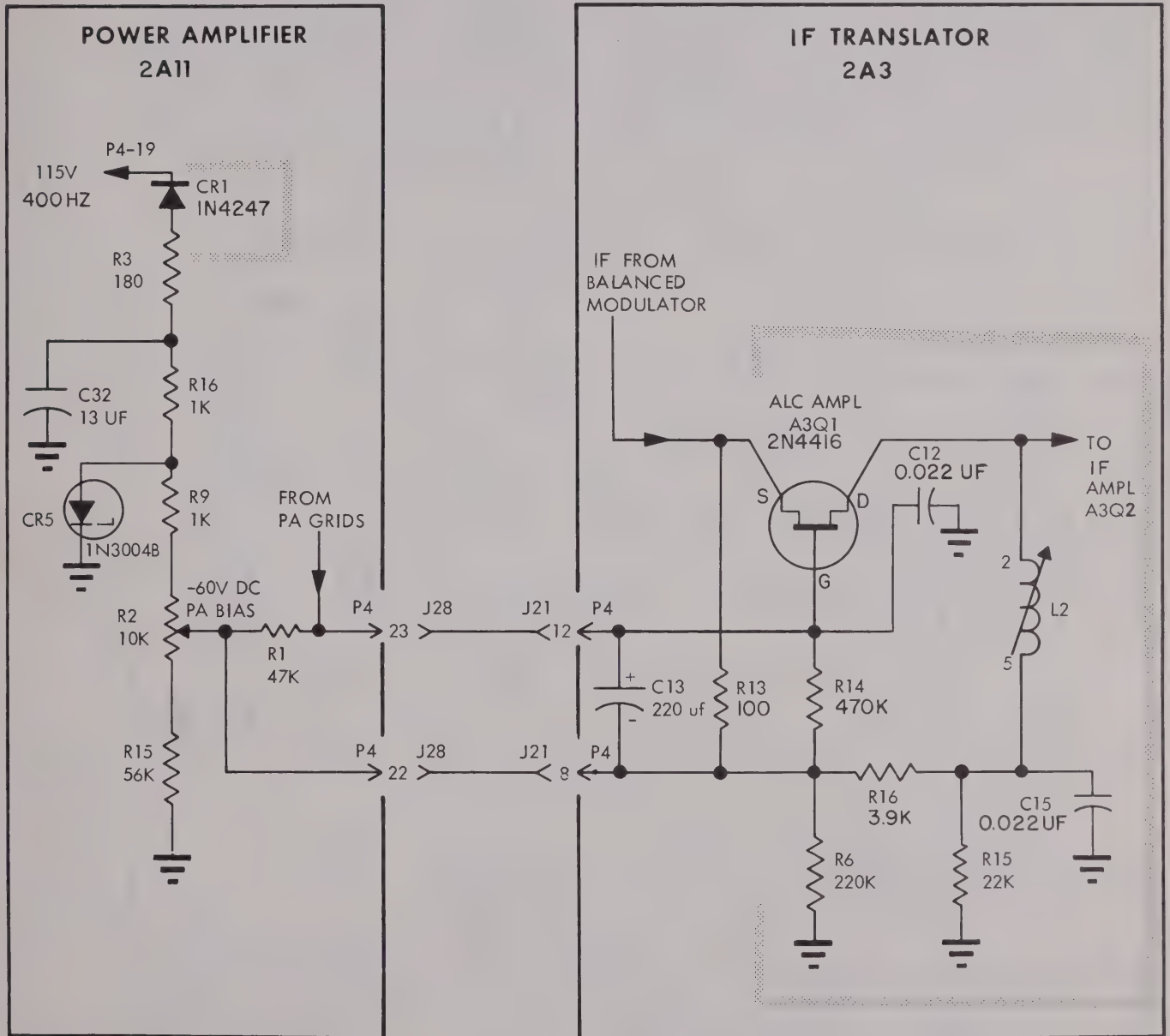
(C) OUTPUT WITH NO AUDIO INPUT



(D) OUTPUT WITH SINGLE TONE AUDIO INPUT

F4JM/HFC-49

Figure 8-21. Balanced Modulator, Simplified Schematic Diagram



F4JM/HFC-48

Figure 8-22. Automatic Load Control, Simplified Schematic Diagram

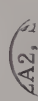


Figure 8-23. Transmitter Gain Control and Automatic Drive Control Circuits, Simplified Schematic Diagram

gradually increases the transmitter gain from a low value to its normal value when the transmitter is keyed. Capacitor 2A3C54, connected to the base of transistor 2A3Q6, is charged through resistor 2A3R39 to 18 volts when the transceiver is in the receive mode. When the transmitter is keyed, capacitor 2A3C54 discharges through resistor 2A3R39. As a result, a negative voltage is placed on the base of transistor 2A3Q6, cutting off the transistor at the instant the transmitter is keyed. As capacitor 2A3C54 discharges, the base of transistor 2A3Q6 becomes less and less negative until the input is biased forward and the amplifier is operating normally. The dis-

charge time of the circuit is approximately 100 milliseconds.

8-95. In the receiver mode, IF translator 2A3 converts the signal from IF mixer 2A12V8 to audio at the product detector in either LSB or USB mode. The signal is amplified by IF amplifier 2A3Q2, applied through the appropriate sideband filter, further amplified by IF amplifiers 2A3Q3 through 2A3Q5, and applied to the product detector. The signal is mixed with the 500-KHZ IF in the product detector. The difference frequency output of the product detector is the audio signal. A low-pass filter at the

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2A2,

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product detector output filters out the higher order mixer products. The product detector output is fed through AM/SB switching relay 2A3K3 to the audio amplifier in AM/audio amplifier 2A9.

8-96. The gain of IF amplifiers 2A3Q2 and 2A3Q3 is controlled by an automatic gain control voltage that is a combination of voltages from two sources. A portion of this automatic gain control voltage comes from AM automatic gain control detector 2A9CR5 in AM/audio amplifier 2A9. The other portion comes from audio automatic gain control detector 2A9CR2. The IF amplifiers in IF translator 2A3 receive both IF and audio automatic gain control from AM/audio amplifier 2A9.

8-97. TEST PROCEDURES.

8-98. TEST SETUP.

8-99. Before interconnecting equipment, ensure that all primary power switches are placed in OFF position.

### WARNING

Before connecting the primary power cable to the bench, make sure that a ground strap is connected between the ground lug on the bench and the nearest ground point of the primary power source.

Interconnect test equipment as shown in figure 2-1. Deviations from the test equipment hookup diagram are covered in the test procedures. Test equipment required is listed in figure 3-1.

### NOTE

Equivalent test equipment may be used.

8-100. INITIAL CONTROL SETTINGS.

8-101. Refer to figure 6-8. Deviations from the initial control settings are covered in the test procedures.

8-102. MODULE TEST PROCEDURE.

8-103. Perform the test procedures of figure 8-24 in the order given.

8-104. TROUBLE ANALYSIS.

8-105. Trouble analysis information is incorporated in the PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY column of figure 8-24.

8-106. DISASSEMBLY.

8-107. Disassembly of IF translator 2A3 is self-evident.

8-108. INSPECTION, CLEANING, AND REPAIR.

8-109. Inspection, cleaning, and repair information is contained in section X.

8-110. ASSEMBLY.

8-111. Assembly of IF translator 2A3 is self-evident.

8-112. MODIFICATION HISTORY.

8-113. GENERAL. The following paragraph contains the modification history for IF translator 2A3. The history is arranged by MCN or configuration identifier (CI) effectivity. In some cases, it was not necessary to record the MCN effectivity.

8-114. IF TRANSLATOR 2A3. The modification history is as follows:

### NOTE

Reference designations are abbreviated. Prefix designations with 2A3.

- a. Added resistor R49 (56,000 ohms).
- b. Added capacitor C84 (100 microfarads).
- c. Changed diodes CR3 and CR4 from 1N198 to JAN 1N933.
- d. At CI 73315, deleted diode CR1 and replaced it with four 1N4454 diodes CR8 thru CR11.
- e. At REV LTR N, changed resistor R16 from 1500 to 3.9K.
- f. At REV LTR P:
  1. Deleted 220-microfarad capacitor C82.
  2. Deleted 47K resistor R17.
  3. Changed transistor Q1 from 2N78 to 2N4416.
  4. Added 1N751A zener diode CR13.
  5. Changed capacitors C11 and C15 from 0.02 to 0.01 microfarad.
  6. Changed resistor R13 from 6800 to 100 ohms.
  7. Changed resistor R14 from 15 to 470K.
  8. Changed transistors Q2 thru Q5 from 2N274 to 2N3135.
- g. At REV LTR M, changed R25 to test select value.
- h. At REV LTR N, changed C38 from 0.05 to 0.1 microfarad.
- i. At REV LTR P, changed capacitors C34 and C37 from 0.05 to 0.047 microfarad.
- j. At REV LTR S:
  1. Changed capacitors C11 and C15 from 0.01 to 0.22 microfarad.
  2. Changed capacitors C10 and C12 from 0.02 to 0.022 microfarad.
  3. Changed capacitor C6 from 24 to 39 picofarads.

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
1		Initial test requirements	<p>Refer to figure 8-25 for location of all test points on IF translator 2A3.</p> <p>Remove IF translator 2A3 from radio receiver-transmitter chassis, and perform visual inspection.</p> <p>Remove dust cover from module to perform this test procedure.</p> <p>Connect IF translator 2A3 through module extender to radio receiver-transmitter chassis.</p> <p>NOTE</p> <p>Unless otherwise specified, all steps are performed with radio set control mode selector set to AM, no signal in, and radio receiver-transmitter unkeyed.</p> <p>Apply 115-volt, 400-HZ, 3-phase primary power to radio set test harness input power cable W20.</p> <p>Apply 115-volt, 60-HZ, single-phase primary power to HVU blower power cable.</p> <p>Position radio set test harness POWER switch to ON.</p> <p>Position radio set control mode selector to AM.</p> <p>NOTE</p> <p>Allow 15 minutes for equipment warm up.</p>	<p>Radio set test harness POWER lamp should light, and radio receiver-transmitter blower should operate.</p> <p><b>CAUTION</b></p> <p>Position POWER switch to OFF immediately if blower does not operate.</p>	<p>Repair or replace faulty POWER lamp and/or blower.</p> <p>NOTE</p> <p>Refer to Radio Set Test Bench AN/ARM-86 (TO 33D7-4-14-1) for repair procedures of faulty equipment contained in AN/ARM-86.</p>
2		Transistor supply voltage check	<p>Connect HP-410B VTVM DC probe to TP5 on module extender.</p> <p>Check voltage at TP5 on module extender.</p>	+17 to +19 VDC.	Check power supply 2A7.

Figure 8-24. IF Translator 2A3, Module Checks and Adjustments (Sheet 1 of 7)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
3	2A3J2 (C2)	TGC voltage check	<p>Connect coaxial jumper between IF OUTPUT jack and unmarked coaxial connector on 2A3 module extender.</p> <p>Connect HP-410B VTVM DC probe to test point (C2).</p> <p>Set radio set control frequency selector knob to 7.300 MHZ.</p> <p>Key radio-receiver-transmitter.</p> <p>Check voltage at test point (C2).</p> <p>Unkey radio receiver-transmitter.</p>	+10 to +14 VDC.	Check 2A3Q6 and associated circuit. Repair or replace faulty component as necessary.
4	2A3J4 (C4)	500-KHZ carrier input to balanced modulator check	<p>Connect HP-410B VTVM AC probe to test point (C4).</p> <p>Key radio receiver-transmitter.</p> <p>Check voltage at test point (C4).</p> <p>Unkey radio receiver-transmitter.</p>	1.4 to 2.0 VRMS.	Check 2A2Q4, 2A2Q5, 2A2Q6, and associated circuits. Repair or replace faulty component as necessary.
5  (Cont)		SSB receive IF alignment	<p>Set radio set control mode selector to USB.</p> <p>Set radio receiver-transmitter front panel AUDIO control fully clockwise.</p> <p>Disconnect jumper from IF OUTPUT connector on module extender.</p> <p>Connect HP-410B VTVM AC probe to radio set test harness HEADSET jack.</p> <p>Connect signal generator through 6-DB attenuator to a BNC T-connector.</p> <p>Connect frequency counter to T-connector.</p> <p>Remove RF translator 2A12 from radio receiver-transmitter chassis and connect remaining portion of T-connector to chassis connector 2J38.</p>		

Figure 8-24. IF Translator 2A3, Module Checks and Adjustments (Sheet 2 of 7)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
5 (Cont)			<p>Set signal generator for 500.3-KHZ CW output.</p> <p>Adjust signal generator output level for 2 to 3 volts at radio set test harness HEADSET jack.</p> <p>NOTE</p> <p>To prevent overloading, maintain voltage at HEADSET jack below 3.5 V by reducing signal generator output level as circuit gain is increased.</p> <p>Adjust 2A3L4, 2A3L5, and 2A3T2 to peak voltage at HEADSET jack.</p> <p>Tune signal generator to 501.0 KHZ.</p> <p>Adjust 2A3C25 and 2A3C29 to peak voltage at HEADSET jack.</p> <p>Determine which sideband has lower gain by keeping signal generator output level constant while switching between LSB (with signal generator tuned to 499.0 KHZ) and USB (with signal generator tuned to 501.0 KHZ). Lower gain sideband has lowest voltage at HEADSET jack.</p> <p>Set radio set control mode selector to the lower gain sideband. Adjust signal generator output level for 3.5 V at HEADSET jack.</p> <p>Note signal generator output level.</p> <p>Disconnect signal generator from radio receiver-transmitter chassis connector 2J38.</p> <p>Reinstall RF translator 2A12 in radio receiver-transmitter chassis.</p> <p>Reset radio receiver-transmitter AUDIO control for 5.5 V at HEADSET jack by performing step 4A of figure 6-9.</p>	Between 40.0 and 100.0 UV.	Select value of 2A3R5 that provides required results from complement given in illustrated parts breakdown (TO 12R2-2ARC105-14).
6 (Cont)		SSB/AM transmit IF alignment	<p>NOTE</p> <p>Perform the SSB receive IF alignment procedure, step 5, before performing this procedure.</p>		

Figure 8-24. IF Translator 2A3, Module Checks and Adjustments (Sheet 3 of 7)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
6 (Cont)			<p>Connect coaxial jumper between RF LOAD and IF OUTPUT coaxial connectors on 2A3 module extender.</p> <p>Connect a type 340 voltmeter to RF test point on 2A3 module extender.</p> <p>Set radio set control mode selector to USB.</p> <p>Place short across 2A3C9 to utilize carrier for alignment.</p> <p>Key radio receiver-transmitter</p> <p>Adjust trimmer on RF LOAD block on 2A3 module extender for peak indication on the type 340 voltmeter.</p> <p>Adjust 2A3T1 and 2A3L2 for a peak on the type 340 voltmeter.</p> <p>Remove short from 2A3C9.</p> <p>Set radio set control mode selector to AM.</p> <p>Check voltage on the type 340 voltmeter.</p> <p>Connect function test set and audio oscillator as shown in figure 2-1.</p> <p>Key radio receiver-transmitter, and set audio oscillator output to 1.0 KHZ, 0.25 V as measured with HP-400D AC VTVM at function test set TEST POINT jack.</p> <p>Determine lower gain sideband by keying radio receiver-transmitter switching between USB and LSB. The setting that gives the lower voltage on the type 340 voltmeter is the lower gain sideband.</p> <p>Set radio set control mode selector to lower gain sideband.</p> <p>Check voltage on the type 340 voltmeter.</p>	<p>0.2 to 0.4 V.</p> <p>0.31 to 0.39 V.</p>	<p>Select value of 2A3R42 that will provide required results from complement given in illustrated parts breakdown (TO 12R2-2ARC105-14).</p> <p>Select value of 2A3R2 that will provide required results from complement given in the illustrated parts breakdown (TO 12R2-2ARC105-14).</p>
(Cont)					

Figure 8-24. IF Translator 2A3, Module Checks and Adjustments (Sheet 4 of 7)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
6 (Cont)			Set to higher gain sideband.  Disconnect audio oscillator.	Within 2 DB of voltage noted in previous step.	Select value of 2A3R45 that will provide required results from complement given in the illustrated parts breakdown (TO 12R2-2ARC105-14).
7		Carrier balance adjustment	NOTE  Step 7A of this procedure does not produce ideal carrier balance. For best results, proceed to step 7B. Step 7B requires the use of a spectrum analyzer.		
7A		Carrier balance adjustment	Connect coaxial jumper between RF LOAD and IF OUTPUT coaxial connectors of 2A3 module extender.  Connect a type 340 voltmeter to RF test point on 2A3 module extender.  Set radio set control mode selector to USB, frequency selector knobs to 2.100 MHZ.  Key radio receiver-transmitter.  Adjust 2A3R9, then 2A3C9, to null voltage on the type 340 voltmeter.  Unkey radio receiver-transmitter.  Set radio set control mode selector to LSB.  Key radio receiver-transmitter.  Adjust 2A3R9, then 2A3C9, to null voltage on the type 340 voltmeter.  Repeat above procedure until null voltages are approximately equal.  Unkey radio receiver-transmitter.		
7B  (Cont)	2A3J2  (C2)	Carrier balance adjustment using spectrum analyzer	Override TGC using function test set as follows:  Connect function test set GRND jack to radio receiver-transmitter chassis.  Connect function test set J2-IF TRANS jack to test point (C2).		

Figure 8-24. IF Translator 2A3, Module Checks and Adjustments (Sheet 5 of 7)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
7B (Cont)	2A1J2 A2		<p>Connect function test set J2-FREQ DIV jack to test point A2.</p> <p>Set function test set TGC and CAPTURE RANGE control counterclockwise and FUNCTION SELECTOR to TGC OVERRIDE.</p> <p>Connect output of audio oscillator to function NO. 1 AUDIO IN jack.</p> <p>Set output of audio oscillator to 900 HZ.</p> <p>Connect output of second audio oscillator to function test set NO. 2 AUDIO IN jack.</p> <p>Set output of second audio oscillator at 2900 HZ.</p> <p>Set radio set control mode selector to USB, frequency selector knobs to 2.100 MHZ.</p> <p>Adjust output level of each audio oscillator, while keying radio receiver-transmitter to provide 0.1 volt by alternately monitoring each output with HP-410B VTVM.</p>		
	2A11J1 I1		<p>Connect VOM positive probe to test point I1 and common probe to I4. Refer to figure 8-58 for location of these test points.</p>		
	2A11J4 I4		<p>Monitor VOM while keying radio receiver-transmitter.</p> <p>Slowly adjust function test set TGC and CAPTURE RANGE control, while keying radio receiver-transmitter, to increase drive to power amplifier module. Stop at point that voltage indicated on VOM begins to change. This point is grid current threshold.</p> <p>Unkey radio receiver-transmitter.</p>		
	2J5 1		<p>Connect spectrum analyzer, through 2- to 8-MHZ capacitive divider, to BNC connector that is in line connected to test point 1.</p> <p>Key radio receiver-transmitter.</p>		
(Cont)					

Figure 8-24. IF Translator 2A3, Module Checks and Adjustments (Sheet 6 of 7)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
7B (Cont)			<p>Monitor RF output voltage with spectrum analyzer, and alternately adjust 2A3C9 and 2A3R9 for minimum carrier level.</p> <p>Set radio set control mode selector to LSB.</p> <p>Monitor RF output voltage with spectrum analyzer, and alternately adjust 2A3C9 and 2A3R9 for minimum carrier level.</p> <p>Alternately adjust 2A3C9 and 2A3R9 in USB and LSB until best compromise is reached.</p> <p>Unkey radio receiver-transmitter.</p>		
8		Disconnect	<p>Turn off power.</p> <p>Disconnect all test equipment.</p> <p>Remove IF translator 2A3 from module extender.</p> <p>Remove module extender from radio receiver-transmitter chassis, replace dust cover on module, and install module in radio receiver-transmitter chassis.</p>		

Figure 8-24. IF Translator 2A3, Module Checks and Adjustments (Sheet 7 of 7)

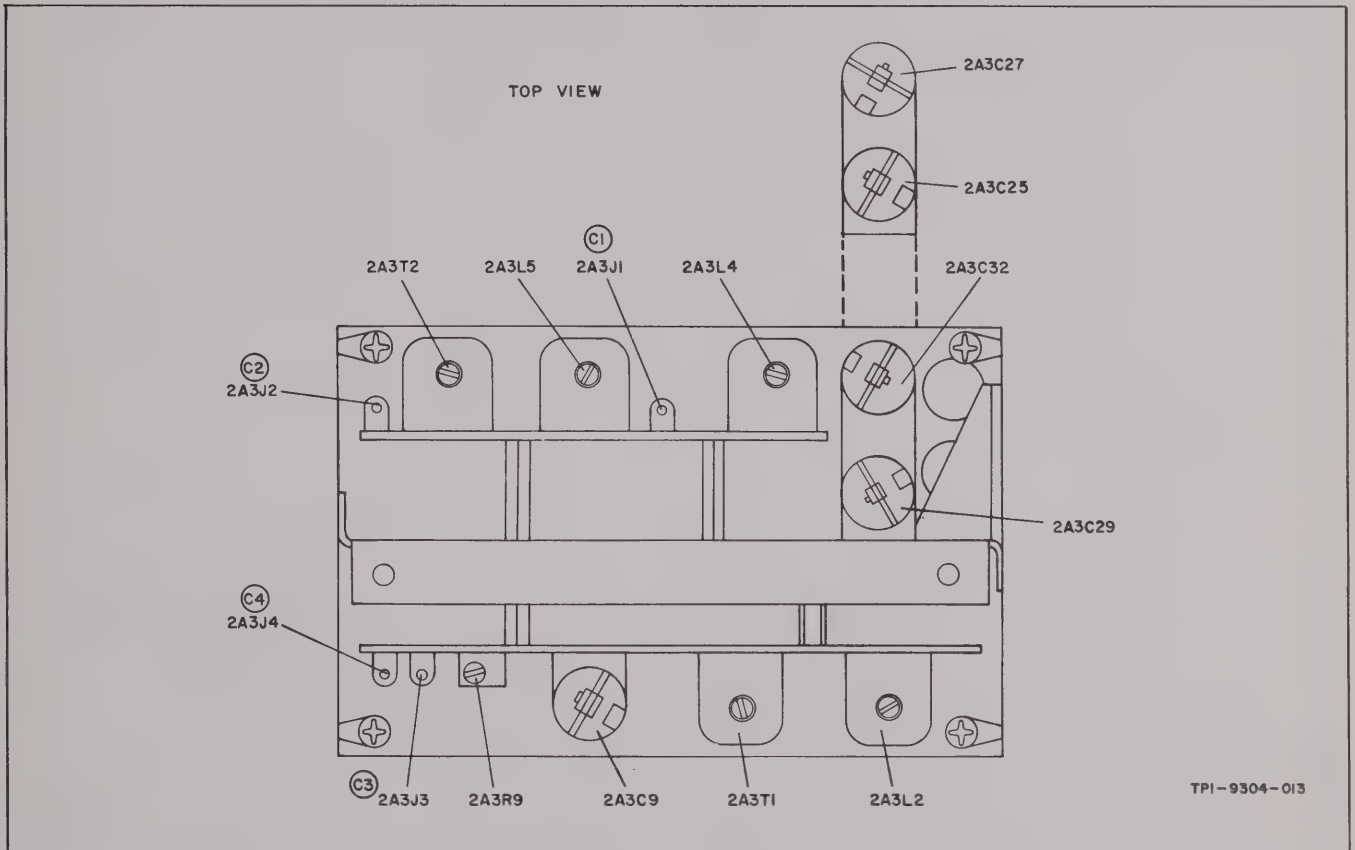


Figure 8-25. IF Translator 2A3, Test-Point and Component Location



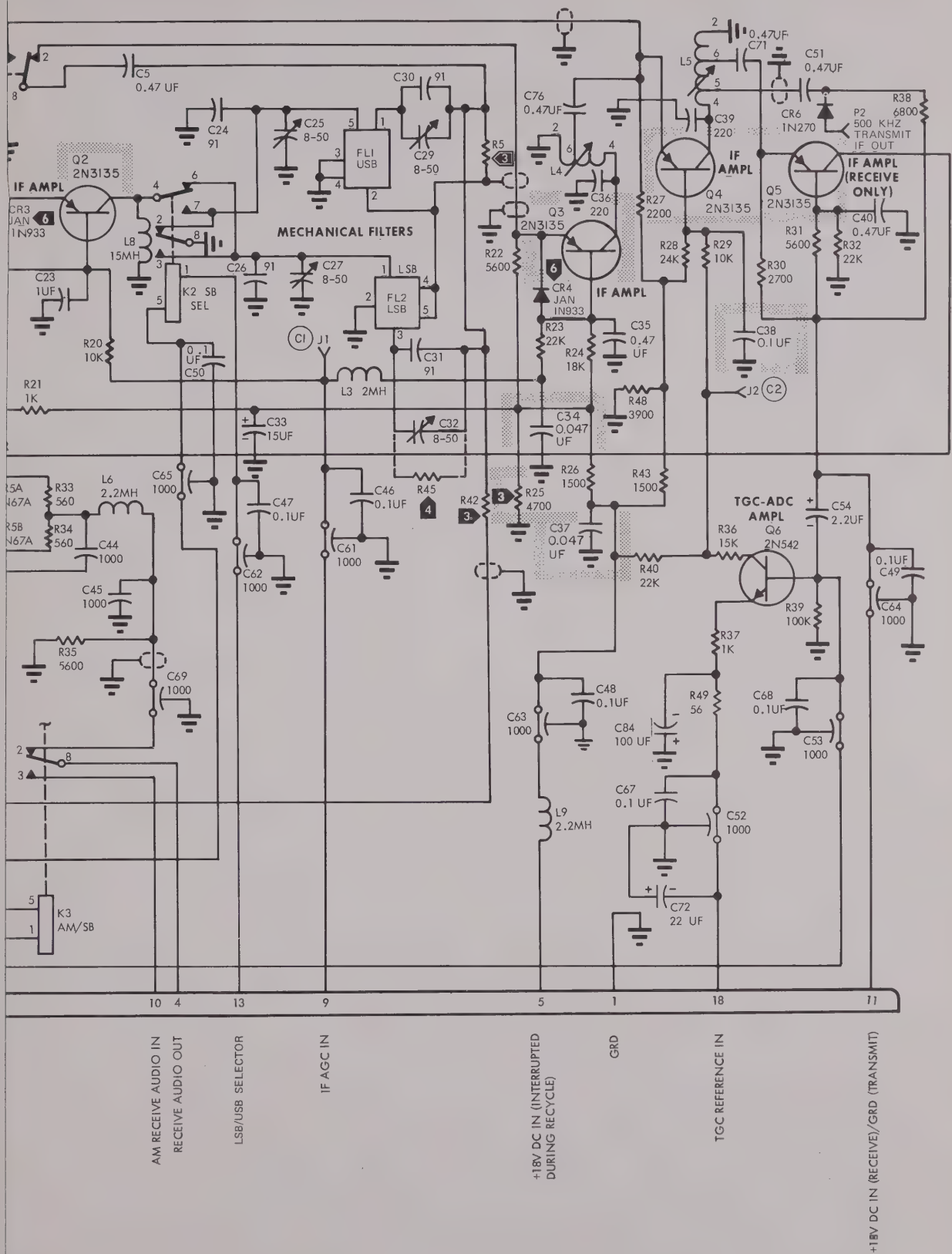


Figure 8-26. IF Translator 2A3, Schematic Diagram



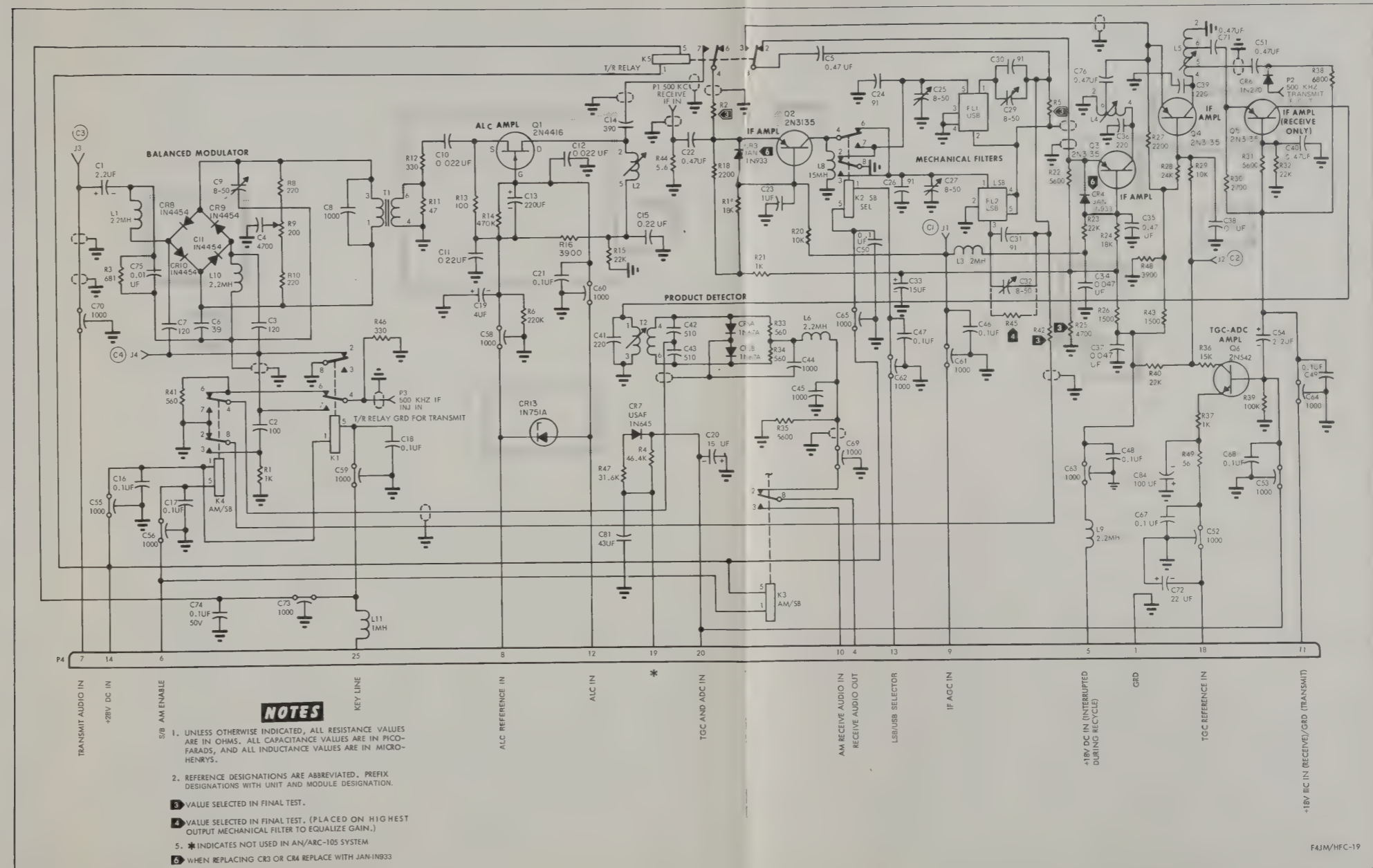
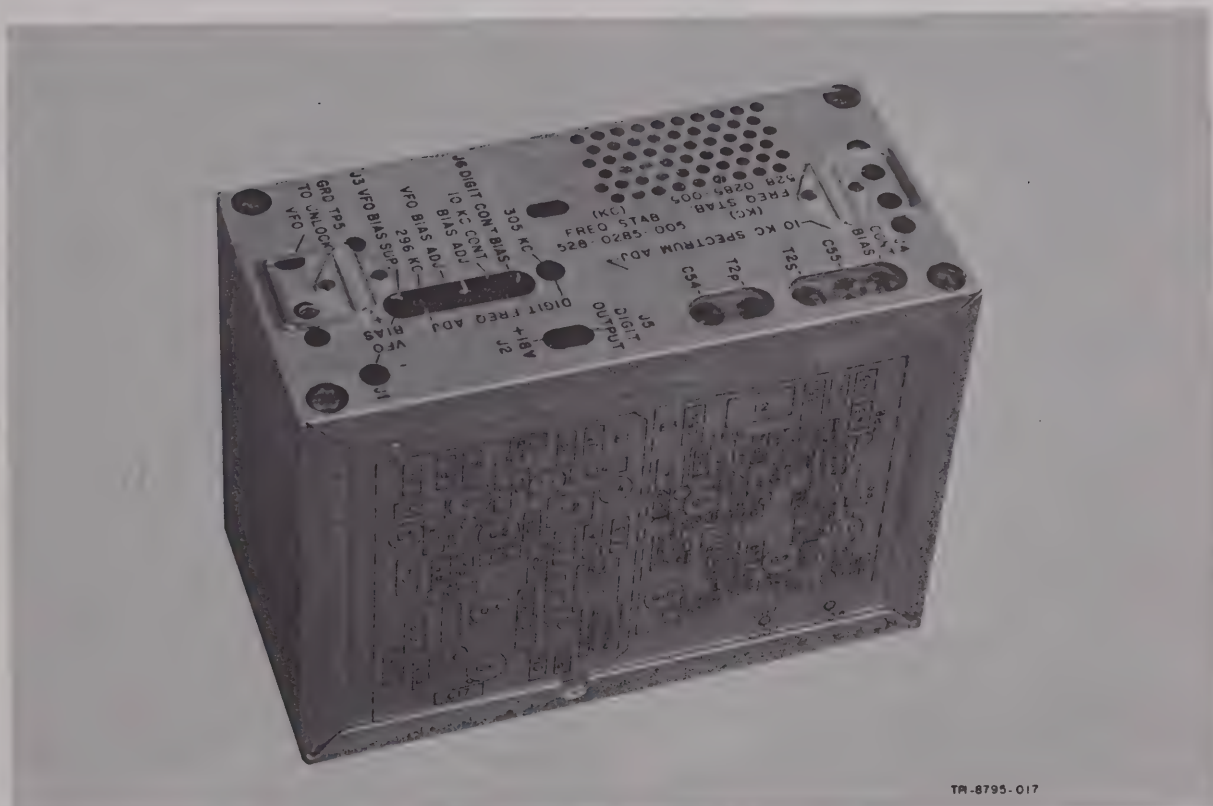


Figure 8-26. IF Translator 2A3, Schematic Diagram



# KC FREQUENCY STABILIZER THEORY AND MAINTENANCE



Paragraph Number

CIRCUIT ANALYSIS	8-116
TEST PROCEDURES	8-128
TEST SETUP	8-129
INITIAL CONTROL SETTINGS	8-131
MODULE TEST PROCEDURE	8-133
TROUBLE ANALYSIS	8-135
DISASSEMBLY	8-137
INSPECTION, CLEANING, AND REPAIR	8-139
ASSEMBLY	8-141
MODIFICATION HISTORY	8-143

Figure 8-27. KC Frequency Stabilizer 2A4, Maintenance Marker

### 8-115. KC FREQUENCY STABILIZER 2A4.

#### 8-116. CIRCUIT ANALYSIS.

8-117. GENERAL. KC frequency stabilizer 2A4 supplies fixed bias and DC control voltages to VFO (variable frequency oscillator) 2A12A2 for frequency stabilization purposes. The DC control voltage is derived by locking the output of the VFO in 1-KHZ steps with reference frequencies from RF oscillator 2A2.

8-118. CIRCUIT ANALYSIS. (Refer to figures 8-28 and 8-32.) The VFO output is phase locked in 1-KHZ steps with the reference frequency of RF oscillator 2A2 by KC frequency stabilizer 2A4. A voltage sensitive capacitor in the tuned circuit of the VFO tunes the VFO in response to a DC tuning voltage from KC frequency stabilizer 2A4. The tuning voltage for this voltage-sensitive capacitor is a combination of an adjustable bias voltage and frequency and phase-proportional control voltages from frequency and phase discriminators in KC frequency stabilizer 2A4.

8-119. The inputs to the phase discriminator are two 250-KHZ signals. One signal is the VFO frequency that has been heterodyned to 250-KHZ, and the other is the crystal RF oscillator frequency that has been heterodyned to 250 KHZ. The phase discriminator output is a DC error signal proportional to the phase difference between the two 250-KHZ signals. This error signal changes the VFO frequency by tuning the voltage-sensitive capacitors in the VFO until the two signals are phase-locked. By phase-locking the VFO to the RF oscillator, the VFO frequency is as accurate as that of the RF oscillator reference frequency.

8-120. The heterodyning of the VFO signal is accomplished as follows: The VFO output, that varies from 2501 to 3500 KHZ in 1-KHZ steps, is amplified by transistor 2A4Q1 and mixed in transistor 2A4Q2 with a spectrum of frequencies spaced 10 KHZ apart. The frequencies in the spectrum are centered 550 KHZ higher than the VFO frequency. As the VFO is tuned from 2501 to 3500 KHZ, the center of the 10-KHZ spectrum moves from 3050 to 4050 KHZ. This 10-KHZ spectrum is derived from the 10-KHZ pulse output of frequency divider 2A1. The 10-KHZ pulse synchronizes monostable multivibrator 2A4Q9 and 2A4Q10 that keys keyed oscillator 2A4Q11 to produce the spectrum. The free-running frequency of this keyed oscillator, to stay 550-KHZ higher than the VFO, determines the frequency about which the 10-KHZ spectrum points are located. The keyed oscillator is tuned by a DC voltage applied to voltage sensitive capacitor 2A4C52. The tuning voltage comes from a divider consisting of precision resistors located in Autopositioner 2A12A1.

8-121. The output of mixer Q2 is the difference between the VFO frequency and the 10-KHZ spectrum frequencies. Therefore, the mixer output contains

frequencies spaced 1-KHZ apart (546 to 555 KHZ) centered around 550 KHZ. The exact frequencies present depend on the frequency of the VFO signal being injected into mixer 2A4Q2. The resultant band of frequencies is fed into a second mixer 2A4Q3 where it is mixed with a signal from free-running digit oscillator 2A4Q12. The digit oscillator output signal is a single frequency that is varied by the 1-KHZ frequency selector knob on the radio set control. The digit oscillator is tuned by voltage sensitive capacitor 2A4C66 to 10 frequencies from 296 to 305 KHZ, 1 KHZ apart. The tuning voltage for the digit oscillator is derived from a precision resistive divider in Autopositioner 2A12A1. When the free-running digit oscillator frequency is mixed in transistor 2A4Q3 with the series of frequencies spaced 1 KHZ apart and centered around 500 KHZ, another band of frequencies is produced, spaced 1 KHZ apart, but centered around 250 KHZ. One of these frequencies will be 250 KHZ plus or minus the VFO frequency error and the digit oscillator frequency error. The output of mixer 2A4Q3 is passed through mechanical filter 2A4FL1, that has a bandwidth of 1 KHZ centered at 250 KHZ. The mixer output frequency near 250 KHZ is passed, but all other frequencies are filtered, since the filter bandwidth extends only 5 KHZ on either side of 250 KHZ, and the nearest frequencies are 10 KHZ away. The signal IF frequency (250 KHZ plus or minus the VFO and digit oscillator errors) is then amplified by IF amplifiers 2A4Q5 through 2A4Q8, and fed to the frequency discriminator. The frequency discriminator output is a DC voltage that varies the capacitance of the voltage-sensitive capacitor to tune the VFO. The frequency discriminator output pulls the VFO signal closer to the desired frequency and within the locking range of the phase discriminator.

8-122. To provide a reference signal for the phase discriminator, the digit oscillator output is mixed in transistor 2A4Q15 with a series of frequencies spaced 1 KHZ apart and centered at 550 KHZ. This 1-KHZ spectrum comes from frequency divider 2A1. When this 1-KHZ spectrum, centered around 550 KHZ, is mixed with the digit oscillator output, the mixer output is a series of frequencies spaced 1 KHZ apart, centered around 250 KHZ. One of these frequencies will be 250 KHZ, plus or minus the digit oscillator error. The output of mixer 2A4Q15 is passed through crystal filter 2A4FL2, which has a bandwidth of 0.8 KHZ centered at 250 KHZ. The mixer output frequency near 250 KHZ (250 KHZ, plus or minus the digit oscillator error) is passed and then amplified by IF amplifiers 2A4Q16 through 2A4Q19 and applied to the phase discriminator.

8-123. For proper operation of the reference IF amplifiers, the digit oscillator must not vary more than 200 HZ from its proper frequency for all conditions of environment. The error in the digit oscillator injection frequency is canceled in the phase discriminator because the oscillator output is mixed with both inputs to the discriminator. The phase discriminator control voltage overrides the frequency

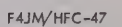


Figure 8-28. KC Frequency Stabilizer 2A4, Block Diagram

discriminator control voltage to lock the phase of the VFO frequency to the phase of the reference frequency, derived from the crystal RF oscillator. Since all of the spectrum point injection frequencies in KC frequency stabilizer 2A4 are derived from the crystal oscillator through frequency divider 2A1, frequency stability depends on the performance of the crystal RF oscillator. The VFO is therefore held as stable as the crystal RF oscillator.

8-124. The AC signal input to KC frequency stabilizer 2A4 from the VFO and the DC control voltage input to the VFO from KC frequency stabilizer 2A4 are both carried by a common line. The AC and DC components are said to be diplexed. The diplexed components are separated in the modules at either side of the line, and the respective desired signals are processed as required.

8-125. Because the frequency of the digit oscillator must be very accurate, the voltage that varies the capacitance of the voltage-sensitive capacitor in the tuned circuit of the oscillator must be very exact. This tuning voltage, as well as the tuning voltages for the voltage-sensitive capacitors that tune the VFO and the keyed oscillator in KC frequency stabilizer 2A4, comes from a bridge circuit. Refer to figure 8-29. Part of the bridge is in KC frequency stabilizer 2A4 and part in Autopositioner 2A12A1.

8-126. The bridge circuit input is 130 volts DC from power supply 2A7. The bridge output is kept constant by the action of three breakdown diodes, 2A4CR6 through 2A4CR8, connected in series. The precision resistive divider in Autopositioner 2A12A1 that tunes the digit oscillator to its 10 increments is placed across the bridge output. The digit oscillator frequency may be adjusted by varying resistor 2A4R59, that is in series with the resistive divider. The voltage tapped from the divider is fed to the voltage-sensitive capacitor in the digit oscillator tuned circuit.

8-127. Bias for the VFO and the voltage for tuning the keyed oscillator in KC frequency stabilizer 2A4 are taken from precision resistive dividers connected across the breakdown-diode leg of the bridge. Currents in both dividers can be varied to produce the correct voltage for changing the capacitance of the voltage-sensitive capacitors. Resistor 2A4R58 is in the bridge circuit opposite the diodes to balance voltage transients on the 130-volt DC supply line. The resistance value of resistor 2A4R58 equals the resistance of the diodes in the breakdown condition.

8-128. TEST PROCEDURES.

8-129. TEST SETUP.

8-130. Before interconnecting equipment, ensure that all primary power switches are placed in OFF position.

## WARNING

Before connecting the primary power cable to the bench, make sure that a ground strap is connected between the ground lug on the bench and the nearest ground point of the primary power source.

Interconnect test equipment as shown in figure 2-1. Deviations from the test equipment hookup diagram are covered in the test procedures. Test equipment required is listed in figure 3-1.

## NOTE

Equivalent test equipment may be used.

8-131. INITIAL CONTROL SETTINGS.

8-132. Refer to figure 6-8. Deviations from the initial control settings are covered in the test procedures.

8-133. MODULE TEST PROCEDURE.

8-134. Perform the test procedures of figure 8-30 in the order given.

8-135. TROUBLE ANALYSIS.

8-136. Trouble analysis information is incorporated in the PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY column of figure 8-30.

8-137. DISASSEMBLY.

8-138. Disassembly of KC frequency stabilizer 2A4 is self-evident.

8-139. INSPECTION, CLEANING, AND REPAIR.

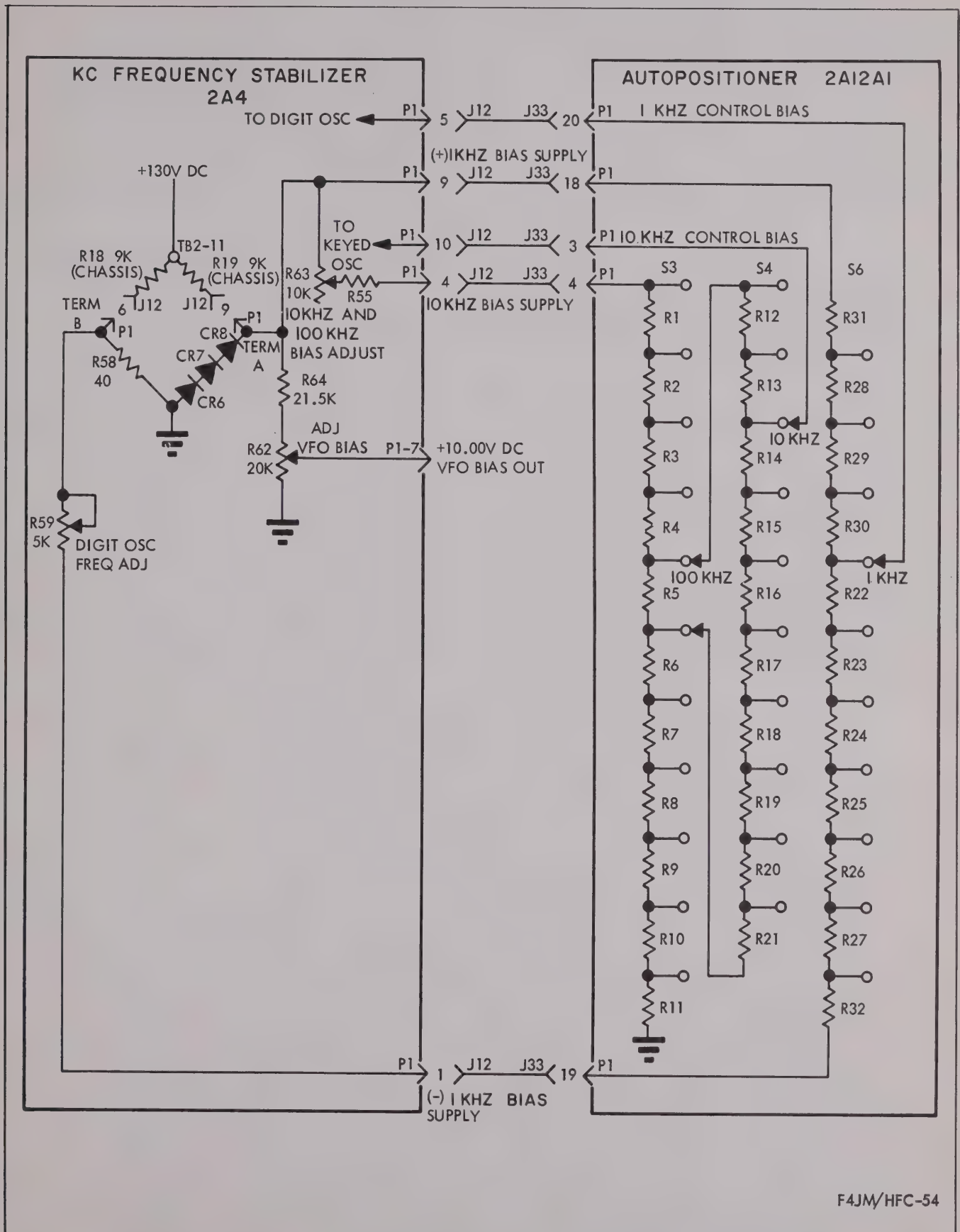
8-140. Inspection, cleaning, and repair information is contained in section X.

8-141. ASSEMBLY.

8-142. Assembly of KC frequency stabilizer 2A4 is self-evident.

8-143. MODIFICATION HISTORY.

8-144. GENERAL. The following paragraph contains the modification history for KC frequency stabilizer 2A4. The modification history is arranged by MCN or configuration identifier (CI) effectivity. In some cases, it was not necessary to record the MCN effectivity.



F4JM/HFC-54

Figure 8-29. Voltage Stabilizing Bridge Circuits, Simplified Schematic Diagram

8-145. KC FREQUENCYSTABILIZER 2A4. The modification history is as follows:

NOTE

Reference designations are abbreviated. Prefix all designations with 2A4.

a. At MCN 170:

1. Changed capacitor C15 from 200 to 150 picofarads.
  2. Changed resistor R13 from 13,000 to 3900 ohms.
  3. Changed capacitor C17 from 510 to 270 picofarads.
- b. Changed diode CR16 from JAN 1N198 to JAN 1N933M.

c. At MCN 1200, added capacitor C128 (0.8 to 8.5 picofarads).

d. At MCN 1867, changed Q9 from USN 2N332 to JAN 2N333.

e. At REV LTR H, changed transistors E5Q14 and E5Q15 from 2N1285 to 2N3323.

f. At REV LTR J, changed transistors E5Q14 and E5Q15 from 2N3323 to 2N3135.

g. At REV LTR L, changed transistors E6Q16 thru E6Q19 from 2N1285 to 2N3323.

h. At REV LTR M, changed transistors E6Q16 thru E6Q19 from 2N3323 to 2N3135.

i. At REV LTR N, changed transistors E1Q1 thru E1Q4 from 2N1285 to 2N3323.

j. At REV LTR P, changed E1Q1 thru E1Q4 from 2N3323 to 2N3135.

k. At REV LTR S, changed transistors E2Q5 thru E2Q8 from 2N1285 to 2N3323.

l. At REV LTR T, changed transistors E2Q5 thru E2Q8 from 2N3323 to 2N3135.

m. At REV LTR U, changed transistor E4Q12 from 2N1285 to 2N3323.

n. At REV LTR V, changed transistor E4Q12 from 2N3323 to 2N3135 and E4C65 from 510 picofarads to test select value.

o. At REV LTR U:

1. Changed E2C36 from 680 to 220 picofarads.
2. Changed E2C37 from test select to 470 picofarads and corrected note 6.

p. At REV LTR V:

1. Changed E2R21 from 240 to 1200 ohms.
2. Changed E2R22 from 4700 to 2700 ohms.
3. Changed E2R23 from 4700 to 1000 ohms.
4. Added resistors E2R100 and E2R101.
5. Added note 9.

q. At REV LTR N, changed E6R84 from 1800 to 4700 ohms.

r. At REV LTR K, changed E5R72 from 150 to 82K.

s. At REV LTR R:

1. Changed resistors E1R7 and E1R10 from 150 to 82K.

2. Changed resistor E1R13 from 39 to 27K.

t. At REV LTR W, changed capacitor E2C29 from 0.05 to 0.47 microfarad.

u. At REV LTR Y, changed diodes E4CR7 thru E4CR9 from 1N2167A to 1N939B.

v. Changed E3Q11 from 1N270 to 2N128.

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
1		Initial test requirements	<p>Refer to figure 8-31 for location of all test points on KC frequency stabilizer 2A4.</p> <p>Remove KC frequency stabilizer 2A4 from radio receiver-transmitter chassis, and perform visual inspection.</p> <p>Remove dust cover from module to perform this test procedure.</p> <p>NOTE</p> <p>Some of the following test points and adjustments are located on circuit board 2A4E2. This board is located behind circuit board 2A4E6. Refer to figure 8-31 for location of circuit boards. To make test points and adjustments on 2A4E2 accessible, remove 2A4E6 and the metal divider between 2A4E6 and 2A4E2 by removing five screws from 2A4E6.</p> <p>Connect KC frequency stabilizer through module extender to radio receiver-transmitter chassis.</p> <p>NOTE</p> <p>Unless otherwise specified, all steps are performed with radio set to AM, no signal in, and radio receiver-transmitter unkeyed.</p> <p>Apply 115-volt, 400-HZ, 3-phase primary power to radio set test harness input power cable W20.</p> <p>Apply 115-volt, 60-HZ, single-phase primary power to HVU blower power cable.</p>		
(Cont)					

Figure 8-30. KC Frequency Stabilizer 2A4, Module Checks and Adjustments (Sheet 1 of 14)



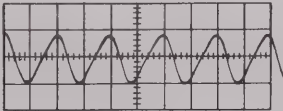
STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
1 (Cont)			<p>Position radio set test harness POWER switch to ON.</p> <p>Position radio set control mode selector to AM.</p> <p>NOTE</p> <p>Allow 15 minutes for equipment to warm up.</p>	<p>Radio set test harness POWER lamp should light, and radio receiver-transmitter blower should operate.</p> <div style="border: 1px solid black; padding: 5px; text-align: center; margin: 10px 0;"><b>CAUTION</b></div> <p>Position POWER switch to OFF immediately if blower does not operate.</p>	<p>Repair or replace faulty POWER lamp and/or blower.</p> <p>NOTE</p> <p>Refer to Radio Set Test Bench AN/ARM-86 (TO 33D7-4-14-1) for repair procedures of faulty equipment contained in AN/ARM-86.</p>
2	2A4E1J2 (D2)	Transistor supply voltage check	<p>Connect MIL-V-9999 differential voltmeter DC probe to test point (D2).</p> <p>Check voltage at test point (D2).</p>	+17.0 to +19.0 VDC.	Check power supply 2A7.
3	2A4E1J1 (D1)	VFO RF input check	<p>Set oscilloscope for 0.5 V/CM 0.2 US/CM.</p> <p>Connect oscilloscope vertical input to test point (D1).</p> <p>Check waveform at test point (D1).</p>		Check VFO output at test point (J5).
4  (Cont)		VFO bias adjustment	<p>NOTE</p> <p>Do not perform this step unless it is known that function test set is in accurate calibration.</p> <p>Connect function test set 1 GRND jack to radio receiver-transmitter chassis.</p> <p>Set function test set FUNCTION SELECTOR switch to SET LEVEL. Adjust LEVEL SET control until FUNCTION METER indicates +10.</p>		

Figure 8-30. KC Frequency Stabilizer 2A4, Module Checks and Adjustments (Sheet 2 of 14)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
4 (Cont)	2A12J8 (J8) 2A4E1J1 (D1)  2A4J3 (D3)  2A12J8 (J8) 2A4E1J1 (D1) 2A4J3 (D3)		<p style="text-align: center;"><b>CAUTION</b></p> <p>Do not use X10 METER SENSITIVITY switch at this time.</p> <p>Ground test point (J8).</p> <p>Connect function test set J1-KC STAB jack to test point (D1).</p> <p>Set function test set FUNCTION SELECTOR switch to OFF-SET ADJUST. Adjust OFF-SET ADJUST control until the FUNCTION METER indicates 0 when the X10 METER SENSITIVITY switch is operated several times.</p> <p>Connect function test set J3-KC STAB jack to test point (D3).</p> <p>Set function test set FUNCTION SELECTOR switch to 70K-5 VFO BIAS.</p> <p>Operate X10 METER SENSITIVITY switch several times.</p> <p>Unground test point (J8).</p> <p>Disconnect test leads from test point (D1), test point (D3), and chassis.</p>	FUNCTION METER must indicate 0.	2A4E4R62. Adjust to provide required results.
5       (Cont)	2A4E3J4 (D4)	Keyed oscillator adjustment	<p>Connect function test set J4-KC STAB jack to test point (D4).</p> <p>Connect function test set GRND jack to chassis radio receiver-transmitter.</p> <p>Set function test set FUNCTION SELECTOR switch to SET LEVEL.</p> <p>Set function test set LEVEL SET control for FUNCTION METER indication of +10.</p>		

Figure 8-30. KC Frequency Stabilizer 2A4, Module Checks and Adjustments (Sheet 3 of 14)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
5 (Cont)			<p><b>CAUTION</b></p> <p>Do not use X10 METER SENSITIVITY switch at this time.</p> <p>Set radio set control requiring selector knobs to X.000 MHZ.</p> <p>Set function test set FUNCTION SELECTOR switch to 10KC CONTROL BIAS (+20 V).</p> <p>Operate X10 METER SENSITIVITY switch several times.</p> <p>Disconnect test leads from test point (D4) and chassis.</p> <p>Connect HP-410B VTVM dc probe to test point (D4), and check level.</p> <p>Check voltage with radio set control frequency selector knobs set at each frequency listed (voltages approximate).</p> <p>Set oscilloscope to 100 MV/CM and 2 US/CM.</p> <p>Connect oscilloscope vertical input to test point (D7) (output of A4FL1).</p> <p>Set radio set control frequency selector knobs to X.000 MHZ.</p> <p>Adjust 2A4E3C54 and 2A4E3C55 to provide peak waveform at test point (D7).</p> <p>Set radio set control frequency selector knobs to X.999 MHZ.</p> <p>Adjust 2A4E3T2-P and 2A4E3T2-S to provide peak waveform at test point (D7).</p> <p>Disconnect oscilloscope from test point (D7).</p>	<p>FUNCTION METER should indicate 0.</p> <p>Approx +20 VDC.</p> <p>X.111 - +17 VDC. X.222 - +14 VDC. X.333 - +12 VDC. X.444 - +10 VDC. X.555 - +8 VDC. X.666 - +7 VDC. X.777 - +6 VDC. X.888 - +5 VDC. X.999 - +4 VDC.</p>	<p>2A4E4R63. Adjust to provide required results.</p> <p>Autopositioner submodule 2A12A1. Perform applicable test procedure of figure 8-66.</p>
	2A4J7 (D7)				

Figure 8-30. KC Frequency Stabilizer 2A4, Module Checks and Adjustments (Sheet 4 of 14)

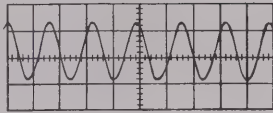
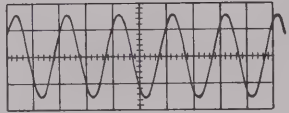
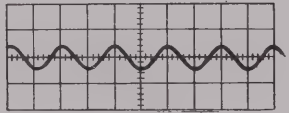
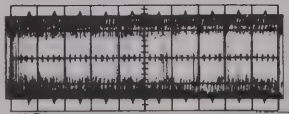
STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
6	2A4E1J5 (D5)	Digit oscillator/isolation amplifier output check	Set oscilloscope for 2.0 V/CM, 2.0 US/CM.  Connect oscilloscope vertical input to test point (D5).  Check waveform at test point (D5).		Check 2A4E1Q4, 2A4E4Q12, and associated circuits. Repair or replace faulty components as necessary.
7	2A4E4J6 (D6)	Digit oscillator dc tuning voltage check	Set radio set control frequency selector knobs to X.XX5 MHZ.  Connect HP-410B VTVM DC probe to test point (D6).  Check voltage at test point (D6).  Set radio set control frequency selector knobs to X.XX6 MHZ.  Check voltage at test point (D6).	Approximately +23.0 V.  Approximately +7 V.	Check 2A12A1R22 through 2A12A1R32 and 2A12A1S6. Repair or replace faulty components as necessary.
8	2A4J7 (D7)	Signal channel IF input check	Set oscilloscope for 50.0 MV/CM, 2.0 US/CM.  Connect oscilloscope vertical input to test point (D7).  Check waveform at test point (D7).		Check 2A4E1Q3, 2A4FL1, and associated circuits.
9	2A4E5J8 (D8)	Reference channel IF input check	Set oscilloscope for 50.0 MV/CM, 2.0 US/CM.  Connect oscilloscope vertical input to test point (D8).  Check waveform at test point (D8).		Check 2A4E5Q15, 2A4FL2, and associated circuits.
10	2A4E1TP1 (D9)	First signal mixer input check	Set oscilloscope for 50.0 MV/CM, 100.0 US/CM.  Connect oscilloscope vertical input to test point (D9).  Check waveform at test point (D9).		Check 2A4E1Q1 and associated circuit.

Figure 8-30. KC Frequency Stabilizer 2A4, Module Checks and Adjustments (Sheet 5 of 14)

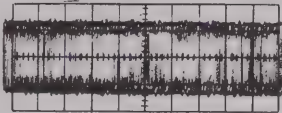
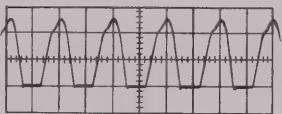
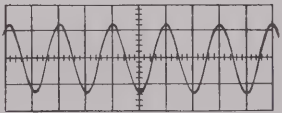
STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
11	2A4E1TP2 (D10)	Second signal mixer input	Set oscilloscope for 100.0 MV/CM, 100.0 US/CM.  Connect oscilloscope vertical input to test point (D10).  Check waveform at test point (D10).		Check 2A4E1Q2 and associated circuit.
12	2A4E2TP4 (D11)	Q6 output/Q7 input check	Set oscilloscope for 1.0 V/CM, 2.0 US/CM.  Connect oscilloscope vertical input to test point (D11).  Check waveform at test point (D11).		Check 2A4E2Q5, 2A4E2Q6, and associated circuits.
13	2A4E2TP5 (D12)	Q8 output/signal input to phase discriminator check	Set oscilloscope for 5.0 V/CM, 2.0 US/CM.  Connect oscilloscope vertical input to test point (D12).  Check waveform at test point (D12).		Check 2A4E2Q7, 2A4E2Q8, and associated circuits.
14	2A4E6 TP15 (D20)  2A4J7 (D7)  2A4E2TP7 (D13)  2A4E6 TP15 (D20)	Frequency discriminator dc output check	Ground test point (D20).  Connect signal generator output through 6-DB attenuator to frequency counter and test point (D7).  Set signal generator for 40-MV output at 250,000 ±5 HZ.  Connect MIL-V-9999 differential voltmeter between test point (D13) and ground.  Disconnect signal generator and VTVM and unground test point (D20).	-5 to +5 MVDC.	Check frequency discriminator circuit.
15 (Cont)	2A4E3TP8 (D14)	Spectrum generator output check	Set oscilloscope for 50.0 MV/CM, 20.0 US/CM.		

Figure 8-30. KC Frequency Stabilizer 2A4, Module Checks and Adjustments (Sheet 6 of 14)

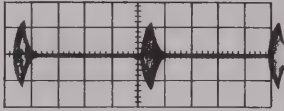
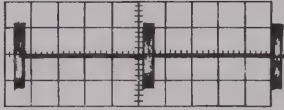
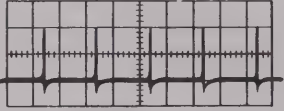
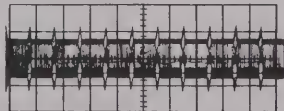
STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
15 (Cont)			Connect oscilloscope vertical input to test point (D14) .  Check waveform at test point (D14) .		Check 2A4E3T2.
16	2A4E3TP9 (D15)	Keyer/keyed oscillator supply voltage check	Connect HP-410B VTVM DC probe to test point (D15) .  Check voltage at test point (D15) .	+17.82 to +18.18 VDC.	Check power supply 2A7.
17	2A4E3 TP10 (D16)	Keyed oscillator output check	Set oscilloscope for 2.0 V/CM, 20.0 US/CM.  Connect oscilloscope vertical input to test point (D16) .  Check waveform at test point (D16) .		Check A4E3Q11 and associated circuit.
18	2A4E3 TP11 (D17)	10-KHZ pulse input from frequency divider A1 check	Set oscilloscope for 2.0 V/CM, 50.0 US/CM.  Connect oscilloscope vertical input to test point (D17) .  Check waveform at test point (D17)		Check 2A1A1Q1 through 2A1A1Q6 and associated circuits.
19	2A4E5 TP12 (D18)	Reference mixer input check	Set oscilloscope to 100.0 MV/CM, 1.0 MS/CM.  Connect oscilloscope vertical input to test point (D18) .  Check waveform at test point (D18) .		Check A4E3Q14 and associated circuit.

Figure 8-30. KC Frequency Stabilizer 2A4, Module Checks and Adjustments (Sheet 7 of 14)

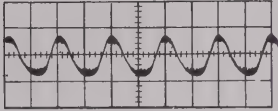
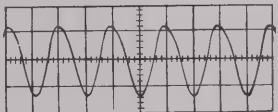
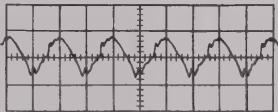
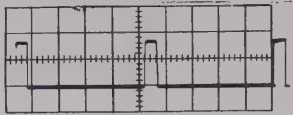
STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
20	2A4E6 TP14 (D19)	Q17 output/A18 input check	Set oscilloscope for 50.0 MV/CM, 2.0 US/CM.  Connect oscilloscope vertical input to test point (D19).  Check waveform at test point (D19).		Check 2A4E6Q16, 2A4E6Q17, and associated circuits.
21	2A4E6 TP15 (D20)	Q19 output/reference input to phase discriminator check	Set oscilloscope for 10.0 V/CM, 2.0 US/CM.  Connect oscilloscope vertical input to test point (D20).  Check waveform at test point (D20).		Check 2A4E6Q18, 2A4E6Q19, and associated circuits.
22	2A4E6 TP16 (D21)	Signal input to phase discriminator check	Set oscilloscope for 5.0 V/CM, 2.0 US/CM.  Connect oscilloscope vertical input to test point (D21).  Check waveform at test point (D21).		Check 2A4E2T1.
23	2A4E2TP5 (D12)  2A4E6 TP15 (D20)  2A4E6TP17 (D22)  2A4E6TP18 (D23)  2A4E2TP5 (D12)	Phase discriminator DC output check	Ground test point (D12) and test point (D20).    Using MIL-V-999 differential voltmeter, check voltage at test point (D22).  Check voltage at test point (D23).  Unground test point (D20) and test point (D12).	-5 +5 MVDC.    -5 to +5 MVDC.	Check phase discriminator circuit.    Same as above.

Figure 8-30. KC Frequency Stabilizer 2A4, Module Checks and Adjustments (Sheet 8 of 14)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
24	2A4E3TP 19 (D24)	Keyer output check	Set oscilloscope for 5.0 V/CM, 20.0 US/CM.  Connect oscilloscope vertical input to test point (D24) .  Check waveform at test (D24) .		Check 2A4E3Q9, 2A4E3Q10, and associated circuits.
25	2A4E4J6 (D6)          2A4E1J5 (D5)	Digit oscillator input check	Connect HP-410B VTVM DC probe to test point (D6) .  Set radio set control frequency selector knobs to X.XX0 MHZ, and check voltage with HP-410B.  Check voltage with radio set control frequency selector knobs set at each frequency listed (voltages approximate).  Connect frequency counter to vertical output of oscilloscope.  Connect vertical input of oscilloscope to test point (D5) through test probe no 1 (supplied in Electronic Maintenance Kit MK-825/ARM-86).  Set radio set control frequency selector knobs to 2.006 MHZ.  Set radio set control frequency selector knobs to 2.005 MHZ.  Reset radio set control frequency selector knobs to 2.006 MHZ.  NOTE  If necessary, readjust 2A4E4R59 and 2A4E4L14 until proper frequency indications are obtained at both 2.006- and 2.005-MHZ frequency settings.	Approx +11 VDC.  X.XX1 - +12.5 VDC. X.XX2 - +14 VDC. X.XX3 - +16.5 VDC. X.XX4 - +19 VDC. X.XX5 - +23 VDC. X.XX6 - +7 VDC. X.XX7 - +8 VDC. X.XX8 - +9 VDC. X.XX9 - +10 VDC.  Counter should indicate between 295.850 to 296.150 KHZ.  Counter should indicate 304.850 to 305.150 KHZ.  Counter should indicate 295.850 to 296.150 KHZ.	Autopositioner sub-module 2A12A1. Perform applicable test procedure of figure 8-66.  2A4E4R59 incorrectly adjusted. Adjust to provide required results.  2A4E4L14 incorrectly adjusted. Adjust to provide required results.

(Cont)

Figure 8-30. KC Frequency Stabilizer 2A4, Module Checks and Adjustments (Sheet 9 of 14)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
25 (Cont)			<p>Set radio set control frequency selector knobs to each of the frequencies listed, and note the frequency counter indication.</p> <p>NOTE</p> <p>If frequency at each digit setting is not within specified limits, replace 2A4E4C64 and 2A4E4C125 with values of capacitance that will give the required indication. A change of +5 PF will raise the frequency at the 2.001-MHZ setting about 10 HZ. Leave a minimum capacitance of 20 PF in the circuit. These capacitors are selected from the complement listed in illustrated parts breakdown (TO 12R2-2ARC105-14).</p> <p>NOTE</p> <p>The remainder of step 25 is optional.</p> <p>Connect KC frequency stabilizer 2A4 to radio receiver-transmitter chassis with an 18-inch pendant cable.</p> <p>Place 2A4 in temperature box.</p> <p>Check all frequencies listed in previous steps at temperatures of -55, -5, +5, +50, and +80 °C.</p> <p>Remove 2A4 from temperature box, and replace on 2A4 module extender.</p>	<p>2.007 MHZ = 297,000 ±150 HZ. 2.008 MHZ = 298,000 ±150 HZ. 2.009 MHZ = 299,000 ±150 HZ. 2.000 MHZ = 300,000 ±150 HZ. 2.001 MHZ = 301,000 ±150 HZ.</p> <p>Frequency at each digit setting must be within ±200 HZ of frequencies listed in previous step.</p>	<p>Replace 2A4E4C64 and 2A4E4C125 with capacitors having the same capacitance but with different temperature coefficients.</p>
26	2A4J7 (D7)	Signal channel input adjustment	<p>Connect vertical input of oscilloscope to test point (D7).</p> <p>Set radio set control frequency selector knobs to X.XX0 MHZ.</p> <p>Adjust 2A4E1L2, 2A4E1L3, 2A4C18, and 2A4C19 to peak waveform at test point (D7).</p> <p>NOTE</p> <p>Check for two tuning points on each capacitor to be sure they are at resonance. Pick the highest point.</p>		

Figure 8-30. KC Frequency Stabilizer 2A4, Module Checks and Adjustments (Sheet 10 of 14)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
27		Signal channel IF/frequency discriminator adjustment	<p>Disconnect module extender from chassis, leaving 2A4 connected to module extender.</p> <p>Connect a #22 wire from pin 2 of chassis connector 2J12 to TP2 on module extender. Connect a #22 wire from radio receiver-transmitter chassis to 2A4 chassis.</p> <p>NOTE</p> <p>Make no other connections between radio receiver-transmitter chassis and module 2A4 or module extender.</p> <p>Connect oscilloscope vertical input to test point (D21).</p> <p>Connect signal generator output through 6-DB attenuator to test point (D7) and frequency counter.</p> <p>Set signal generator output between 249,970 and 250,030 HZ with an output level below that required to saturate IF amplifiers (indicated by output at test point (D21) dropping sharply or clipping).</p> <p>Adjust 2A4E2L7 and 2A4E2T1 to provide peak waveform at test point (D21). If necessary, reduce signal generator output level to prevent amplifier saturation.</p> <p>Connect differential voltmeter between test point (D13) and ground.</p> <p>Check voltage at test point (D13).</p> <p>NOTE</p> <p>The following portion of step 27 needs to be performed only if a component on board 2A4E2 was replaced and if a temperature box is available. If temperature box is unavailable, return module to contractor for repair.</p> <p>Leave signal generator, frequency counter, oscilloscope, and differential VTVM connected as in the previous steps. Maintain signal generator output level as it was in the last step.</p>	0 ±5.0 MV.	Adjust 2A4E2L8 or 2A4E2C128 to provide required results.
(Cont)	2A4E6TP 16 (D21)  2A4J7 (D7)  2A4E6TP 16 (D21)  2A4E2TP7 (D13)				

Figure 8-30. KC Frequency Stabilizer 2A4, Module Checks and Adjustments (Sheet 11 of 14)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
27 (Cont)	2A4E6TP 16 (D21)		<p>Connect 2A4 to chassis through 18-inch pendant cable, and place 2A4 in temperature box. Connect HP-410B VTVM AC probe to test point (D21).</p> <p>Lower temperature box temperature to -55 ° C.</p> <p>Adjust signal generator frequency to produce null on differential VTVM (approximately 250 KHZ).</p> <p>Record output frequency of signal generator and HP-140B indication.</p> <p>Raise temperature box temperature to +80 ° C.</p> <p>Adjust signal generator frequency to provide null on differential voltmeter.</p> <p>Record signal generator output frequency and HP-410B indication.</p> <p>Remove 2A4 from temperature box and replace in radio receiver-transmitter with 2A4 module extender.</p> <p>Remove test equipment from 2A4.</p>	<p>See next step.</p> <p>Signal generator output frequency must be between 249.930 and 250.070 KHZ at both temperatures.</p> <p>HP-410B indications should be with 3 DB of each other.</p>	<p>2A4E2C37 and/or 2A4E2C124. Replace with capacitors having same capacitance but different temperature coefficient.</p> <p>2A4E2C33 and/or 2A4E2C123. Replace with capacitors having same capacitance but different temperature coefficient.</p>
28	2A4J8 (D8)	Reference channel input adjustment	<p>Connect oscilloscope vertical input to test point (D8). Set radio set control frequency selector knobs to X.XX0 MHZ.</p> <p>Adjust 2A4E5L17, 2A4C85, and 2A4C86 to peak waveform at test point (D8).</p> <p>NOTE</p> <p>Check for two tuning points on each capacitor to be sure they are at resonance. Pick highest point.</p> <p>Set radio set control frequency selector knobs to X.XX6 MHZ.</p>		

Figure 8-30. KC Frequency Stabilizer 2A4, Module Checks and Adjustments (Sheet 12 of 14)

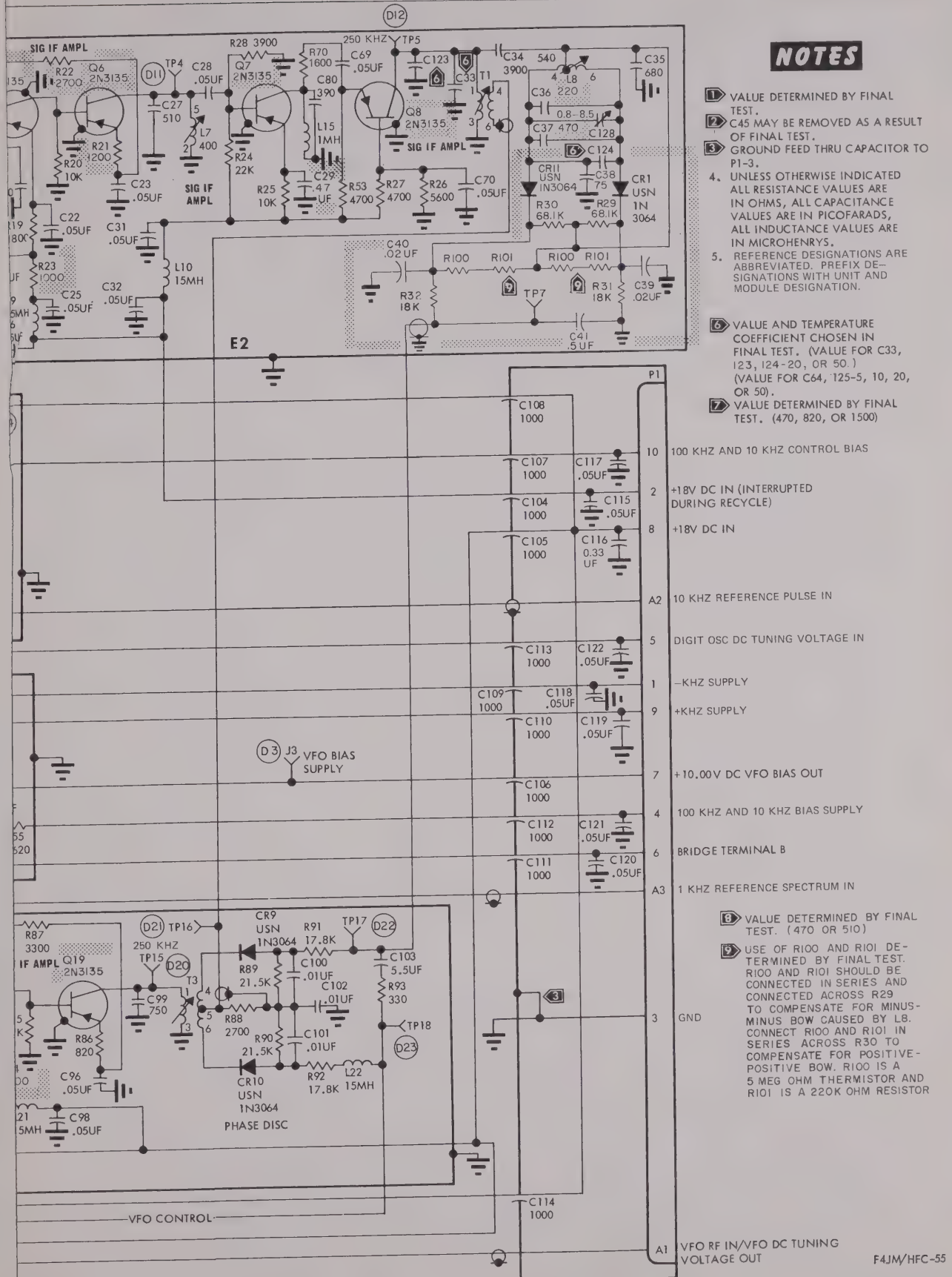
STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
28 (Cont)	2A4J8 (D8)		<p>Adjust 2A1A3L3 in frequency divider 2A1 to peak waveform at test point (D8).</p> <p>Set radio set control frequency selector knobs to X.XX1 MHZ.</p> <p>Adjust 2A1A3L4 in frequency divider 2A1 to peak waveform at test point (D8).</p>		
29	2A4J8 (D8)  2A4E6TP 15 (D20)	Reference channel IF adjustment	<p>Disconnect module extender from radio receiver-transmitter chassis leaving 2A4 connected to module extender.</p> <p>Connect a #22 wire from pin 8 of chassis connector 2J12 to TP8 on module extender.</p> <p>Connect a #22 wire from radio receiver-transmitter chassis to chassis of 2A4.</p> <p>NOTE</p> <p>Make no other connections between radio receiver-transmitter chassis and 2A4 or 2A4 module extender.</p> <p>Connect oscilloscope vertical input to test point (D20).</p> <p>Connect signal generator output through 6-DB attenuator to test point (D8) and frequency counter.</p> <p>Set signal generator output between 249,970 and 250,030 HZ. Set signal generator output level just below that required to saturate IF amplifiers (indicated by clipping at test point (D20)).</p> <p>Adjust 2A4E6L19 and 2A4E6T3 to provide peak waveform at test point (D20). If necessary, reduce signal generator output during peaking procedure to prevent amplifier saturation.</p>		

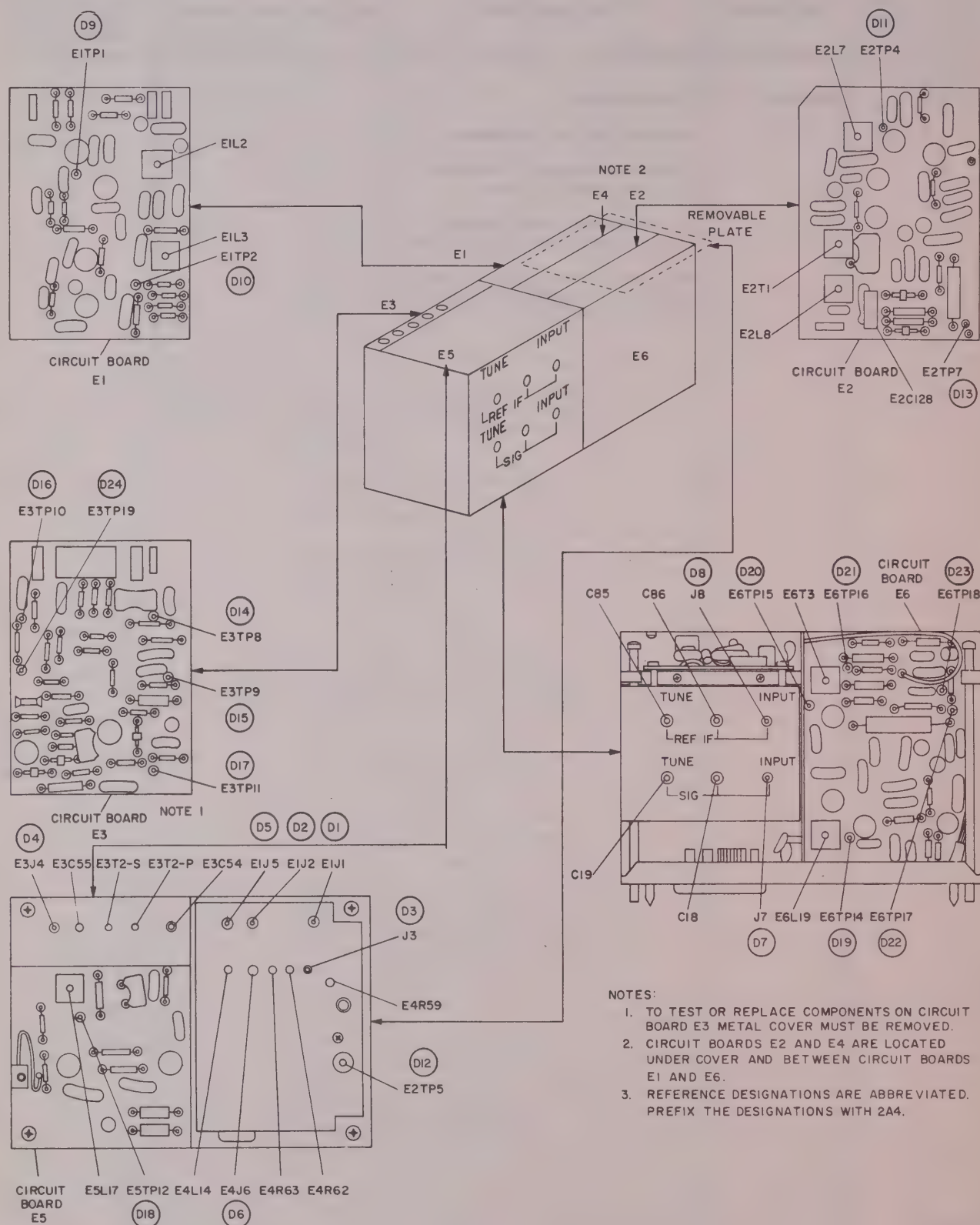
Figure 8-30. KC Frequency Stabilizer 2A4, Module Checks and Adjustments (Sheet 13 of 14)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
30		Disconnect	<p>Turn off power.</p> <p>Disconnect all test equipment.</p> <p>Remove KC frequency stabilizer 2A4 from module extender.</p> <p>Remove module extender from radio receiver-transmitter chassis.</p> <p>Replace dust cover on module and install module in radio receiver-transmitter chassis.</p>		

Figure 8-30. KC Frequency Stabilizer 2A4, Module Checks and Adjustments (Sheet 14 of 14)







TPI-9301-014

Figure 8-31. KC Frequency Stabilizer 2A4, Test-Point and Component Location

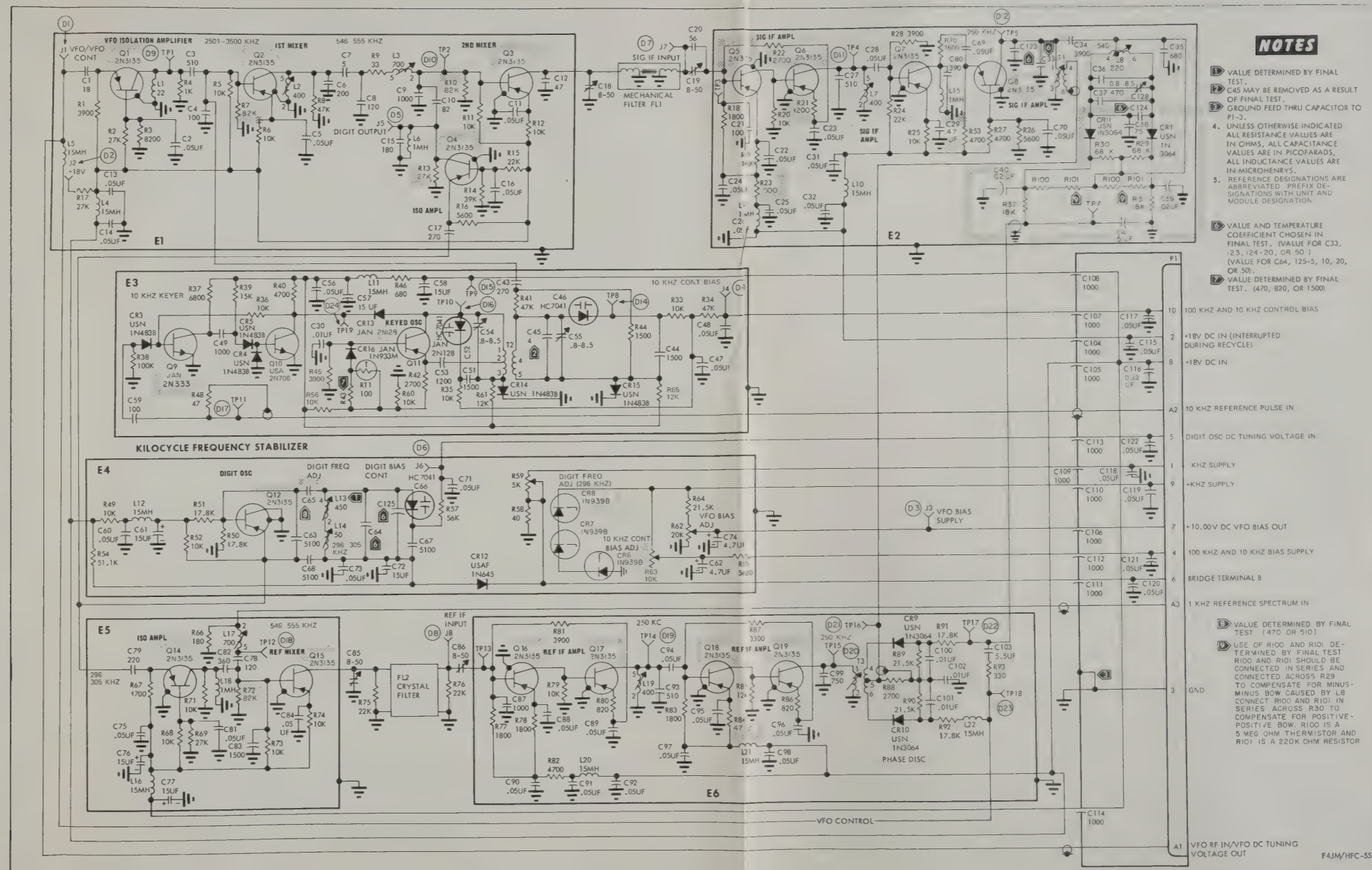
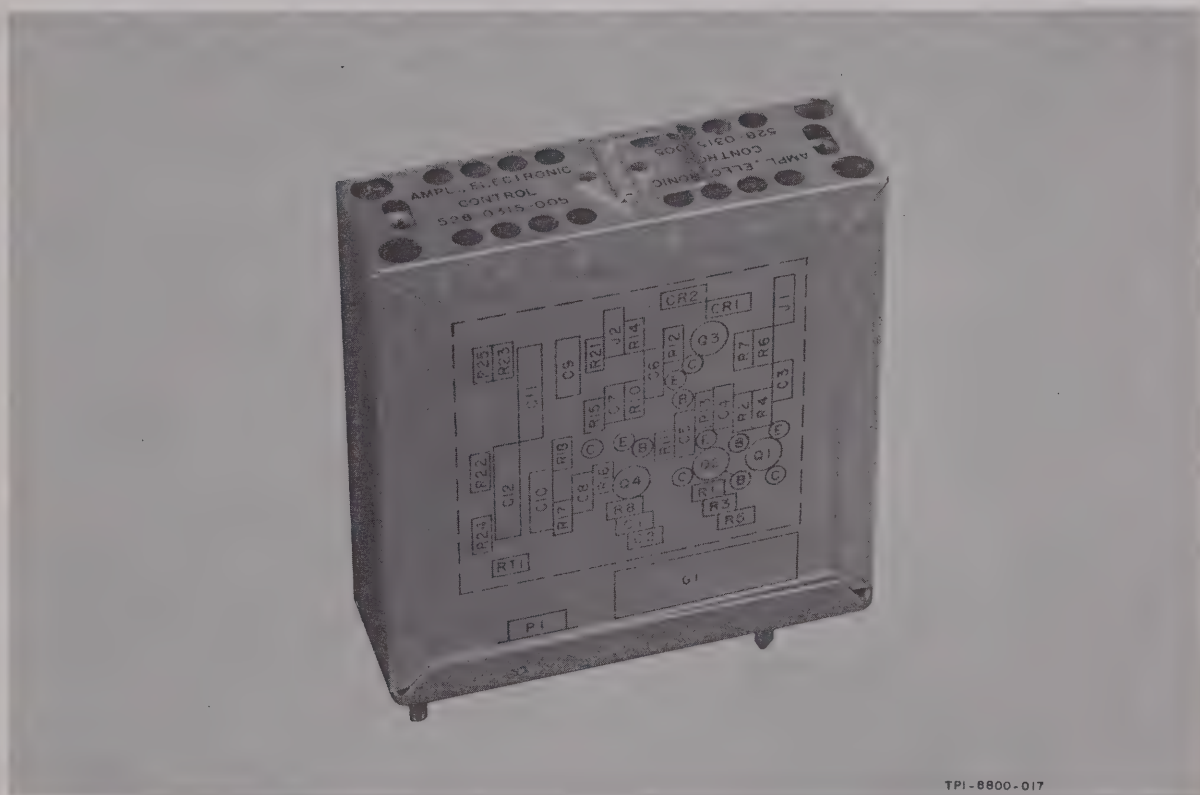


Figure 8-32. KC Frequency Stabilizer 2A4,  
Schematic Diagram



**2A6**  
**ELECTRONIC CONTROL**  
**AMPLIFIER**  
**THEORY AND MAINTENANCE**



TPI-8800-017

**ELECTRONIC CONTROL AMPLIFIER 2A6**

**Paragraph Number**

CIRCUIT ANALYSIS	8-147
TEST PROCEDURES	8-151
TEST SETUP	8-152
INITIAL CONTROL SETTINGS	8-154
MODULE TEST PROCEDURE	8-156
TROUBLE ANALYSIS	8-158
DISASSEMBLY	8-160
INSPECTION, CLEANING, AND REPAIR	8-162
ASSEMBLY	8-164
MODIFICATION HISTORY	8-166

Figure 8-33. Electronic Control Amplifier 2A6, Maintenance Marker

#### 8-146. ELECTRONIC CONTROL AMPLIFIER 2A6.

##### 8-147. CIRCUIT ANALYSIS.

8-148. GENERAL. Electronic control amplifier 2A6 converts a DC error signal from power amplifier 2A11 to a corresponding 400-HZ AC error signal. The AC signal is amplified and fed back to power amplifier 2A11 for tuning purposes. A schematic diagram of electronic control amplifier 2A6 is shown in figure 8-36.

8-149. CIRCUIT ANALYSIS. The input DC error signal from power amplifier 2A11 is converted to a corresponding 400-HZ signal by chopper 2A6G1. This signal is amplified by five cascade amplifiers, 2A6Q1 through 2A6Q5. A paraphase output is taken from the emitter and collector of transistor 2A6Q5 and applied to the respective bases of push-pull power amplifiers 2A6Q6 and 2A6Q7. This output is amplified in the power amplifiers and fed back to the servo motor that tunes the output network of power amplifier 2A11.

8-150. Collector current regulation for the push-pull amplifiers is provided by thermistor 2A6RT1 that is in the common base return circuit of push-pull power amplifiers 2A6Q6 and 2A6Q7.

##### 8-151. TEST PROCEDURES.

##### 8-152. TEST SETUP.

8-153. Before interconnecting equipment, ensure that all primary power switches are placed in OFF position.

### WARNING

Before connecting the primary power cable to the bench, make sure that a ground strap is connected between the ground lug on the bench and the nearest ground point of the primary power source.

Interconnect test equipment as shown in figure 2-1. Deviations from the test equipment hookup diagram are covered in the test procedures. Test equipment required is listed in figure 3-1.

#### NOTE

Equivalent test equipment may be used.

##### 8-154. INITIAL CONTROL SETTINGS.

8-155. Refer to figure 6-8. Deviations from the initial control settings are covered in the test procedures.

##### 8-156. MODULE TEST PROCEDURE.

8-157. Perform the test procedures of figure 8-34 in the order given.

##### 8-158. TROUBLE ANALYSIS.

8-159. Trouble analysis information is incorporated in the PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY column of figure 8-34.

##### 8-160. DISASSEMBLY.

8-161. Disassembly of electronic control amplifier 2A6 is self-evident.

##### 8-162. INSPECTION, CLEANING, AND REPAIR.

8-163. Inspection, cleaning, and repair information is contained in section X.

##### 8-164. ASSEMBLY.

8-165. Assembly of electronic control amplifier 2A6 is self-evident.

##### 8-166. MODIFICATION HISTORY.

8-167. GENERAL. The following paragraph contains the modification history for electronic control amplifier 2A6. The modification history is arranged by MCN or configuration identifier (CI) effectivity. In some cases, it was not necessary to record the MCN effectivity.

8-168. ELECTRONIC CONTROL AMPLIFIER 2A6. The modification history is as follows:

#### NOTE

Reference designations are abbreviated. Prefix designations with 2A6.

- a. Changed diodes CR1 and CR2 from PS6903 to 1N964B.
- b. At MCN 422:
  1. Changed capacitors C3, C4, and C7 from 40 to 39 microfarads.
  2. Changed transistors Q6 and Q7 from 2N457 to USA-2N457A.
- c. Changed transistor Q5 from 2N457 to USA-2N457A.
- d. Changed capacitor C6 from 40 to 39 microfarads.
- e. Added polarity to capacitors C11 and C12.
- f. At REV LTR U, changed transistors Q1 thru Q4 from USN 2N652A to JAN 2N652.

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
1		Initial test requirements	<p>Refer to figure 8-35 for location of all test points on electronic control amplifier 2A6.</p> <p>Remove electronic control amplifier 2A6 from radio receiver-transmitter chassis, and perform visual inspection.</p> <p>Remove dust cover from module to perform this test procedure.</p> <p>Connect electronic control amplifier 2A6 through module extender to radio receiver-transmitter chassis.</p> <p>NOTE</p> <p>Unless otherwise specified, all steps are performed with radio set control mode selector set to AM, no signal in, and radio receiver-transmitter unkeyed.</p> <p>Apply 115-volt, 400-HZ, 3-phase primary power to radio set test harness input power cable W20.</p> <p>Apply 115-volt, 60-HZ, single-phase primary power to HVU blower power cable.</p> <p>Position radio set test harness POWER switch to ON.</p> <p>Position radio set control mode selector to AM.</p> <p>NOTE</p> <p>Allow 15 minutes for equipment to warm up.</p>	<p>Radio set test harness POWER lamp should light and radio receiver-transmitter blower should operate.</p> <p><b>CAUTION</b></p> <p>Position POWER switch to OFF immediately if blower does not operate.</p>	<p>Repair or replace faulty POWER lamp and/or blower.</p> <p>NOTE</p> <p>Refer to Radio Set Test Bench AN/ARM-86 (TO 33D7-4-14-1) for repair procedures of faulty equipment contained in AN/ARM-86.</p>
2	2A6J1 E1	2A6Q1 output/ 2A6Q2 input voltage check	<p>Connect HP-410B VTVM DC probe to test point E1.</p> <p>Check voltage at test point E1.</p>	+5.8 to +7 VDC.	Check 2A6G1, 2A6Q1, and associated circuits.

Figure 8-34. Electronic Control Amplifier 2A6, Module Checks and Adjustments (Sheet 1 of 3)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
3	2A6J2 (E2)	2A6Q4 output voltage check	Connect HP-410B VTVM DC probe to test point (E2).  Check voltage at test point (E2).	+5.1 to +6.1 VDC.	Check 2A6Q2, 2A6Q3, 2A6Q4, and associated circuits.
4	2A6J3 (E3)  2A6J4 (E4)	Push-pull amplifier output voltage check	Connect HP-410B VTVM DC probe to test point (E3).  NOTE  Isolate VTVM primary power third wire ground when making balanced output readings.  Connect HP-410B VTVM common probe to test point (E4).  Check voltage between test point (E3) and test point (E4).  Disconnect HP-410B VTVM.	Not more than +0.2 VDC.	Check 2A6Q5, 2A6Q6, 2A6Q7, and associated circuits.
5	2A6J3 (E3) 2A6J4 (E4)	Amplifier gain check	Set radio set control mode selector to AM and frequency selector knobs to X.500 MHZ.  Connect HP-410B VTVM DC probe to TP9 on module extender.  Connect HP-400D AC VTVM between test point (E3) and test point (E4).  NOTE  Isolate VTVM primary power third wire ground when making balanced output readings.  Key radio receiver-transmitter.  Rotate large roller coil gear on top of power amplifier 2A11 in either direction until amplifier input voltage at TP9 on module extender is $0 \pm 0.2$ V.  Check voltage between test point (E3) and test point (E4).	Between +18 and +30 V.  If voltage is normal, roller coil gear should return to tuned position when released.	Check 2A6Q5, 2A6Q6, 2A6Q7, and associated circuits.  Check for insufficient torque and mechanical binding of roller coil mechanism.

Figure 8-34. Electronic Control Amplifier 2A6, Module Checks and Adjustments (Sheet 2 of 3)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
6		Disconnect	<p>Turn off power.</p> <p>Disconnect all test equipment.</p> <p>Remove electronic control amplifier 2A6 from module extender.</p> <p>Remove module extender from radio receiver-transmitter chassis.</p> <p>Replace dust cover on module, and install module in radio receiver-transmitter chassis.</p>		

Figure 8-34. Electronic Control Amplifier 2A6, Module Checks and Adjustments (Sheet 3 of 3)

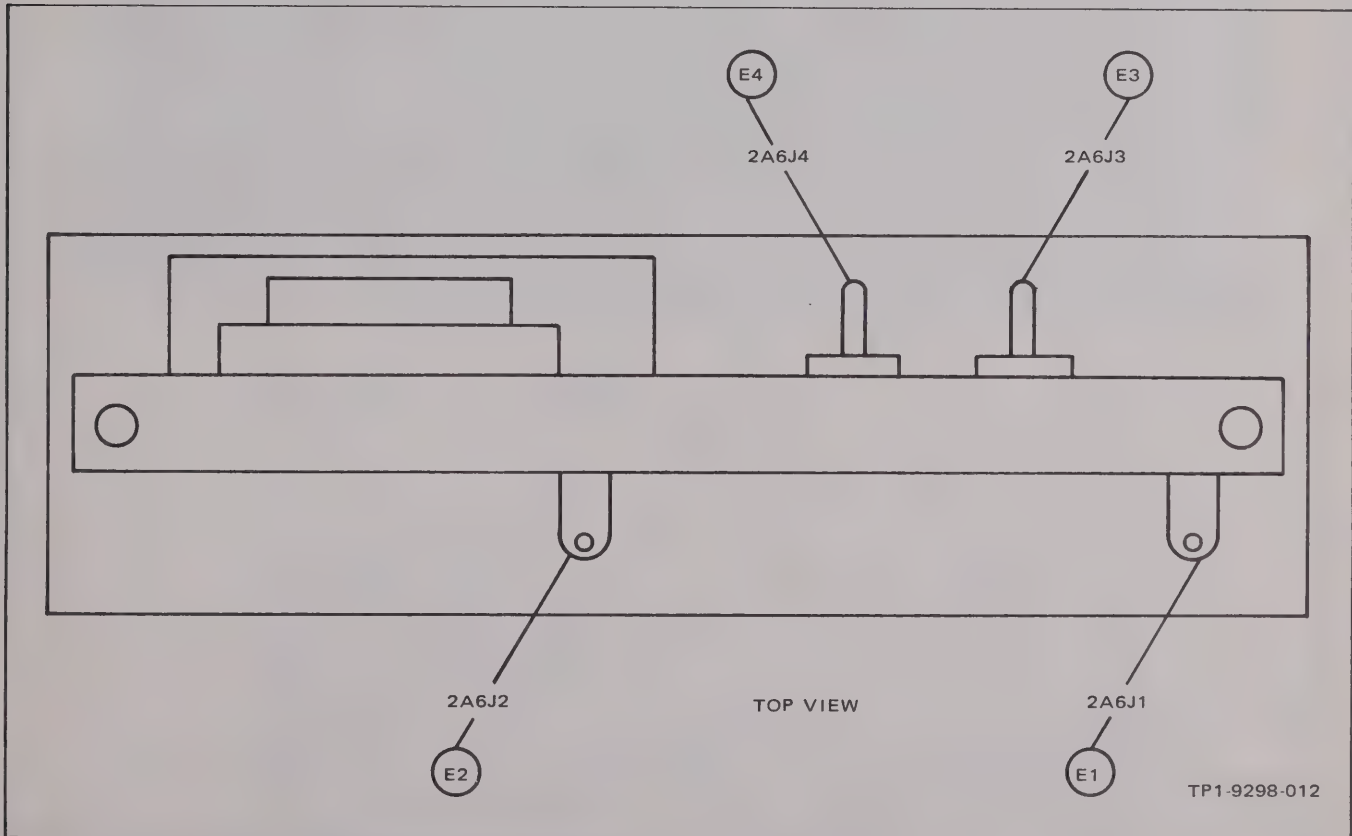
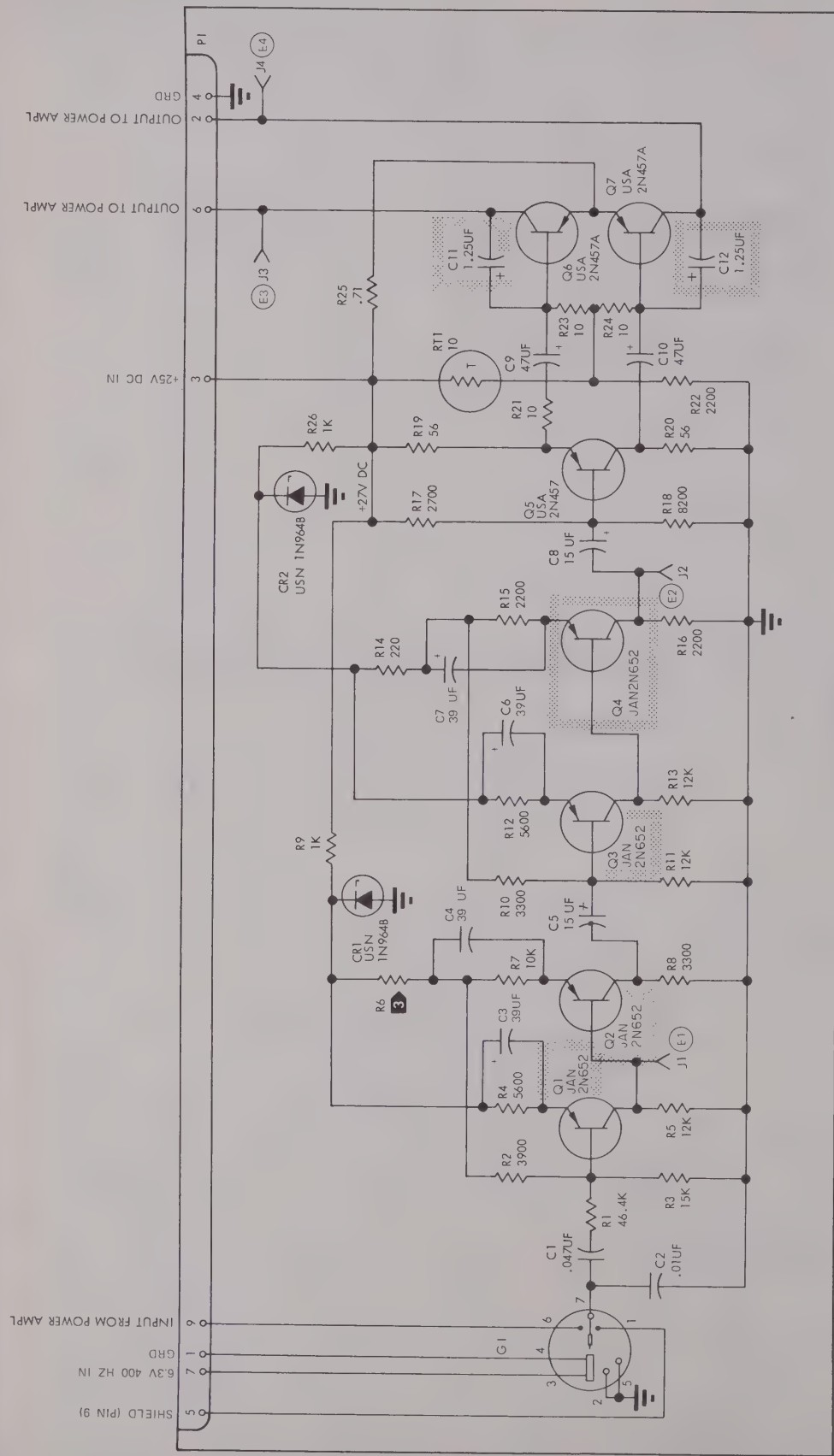


Figure 8-35. Electronic Control Amplifier 2A6, Test-Point Location

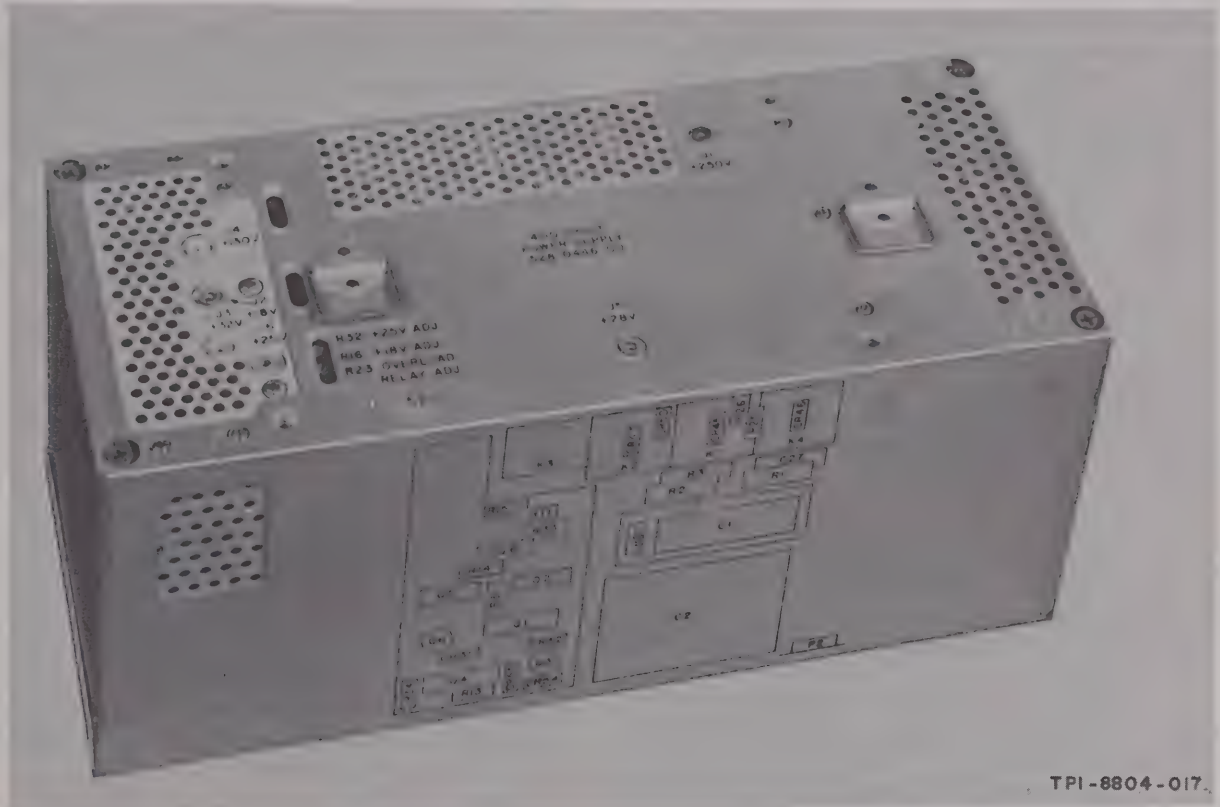


**NOTES**

1. UNLESS OTHERWISE INDICATED RESISTANCE VALUES ARE IN OHMS; CAPACITANCE VALUES ARE IN PICOFARADS AND INDUCTANCE VALUES ARE IN MICROHENRY'S.
2. REFERENCE DESIGNATIONS ARE ABBREVIATED, PREFIX WITH UNIT AND MODULE REFERENCE DESIGNATIONS.
3. SELECTED DURING FINAL ASSEMBLY TEST FROM FOLLOWING VALUES: 100, 120, 150, 180 AND 220.

Figure 8-36. Electronic Control Amplifier 2A6, Schematic Diagram

**2A7**  
**POWER SUPPLY**  
**THEORY AND MAINTENANCE**



TPI-8804-017

**POWER SUPPLY 2A7**

	Paragraph Number
CIRCUIT ANALYSIS	8-170
TEST PROCEDURES	8-180
TEST SETUP	8-181
INITIAL CONTROL SETTINGS	8-183
MODULE TEST PROCEDURE	8-185
TROUBLE ANALYSIS	8-187
DISASSEMBLY	8-189
INSPECTION, CLEANING, AND REPAIR	8-191
ASSEMBLY	8-193
MODIFICATION HISTORY	8-195

Figure 8-37. Power Supply 2A7, Maintenance Marker

### 8-169. POWER SUPPLY 2A7.

#### 8-170. CIRCUIT ANALYSIS.

8-171. GENERAL. (Refer to figure 8-40.) Power supply 2A7 is comprised of two sections, a high- and low-voltage section. The high-voltage section supplies 250-volt DC plate voltage to RF translator 2A12, 1500-volt DC plate voltage to power amplifier 2A11, and transmitter gain control voltage. The low-voltage section supplies 130-volt DC line voltage and filament voltage. It also includes an 18-volt DC power supply that provides the highly regulated voltage required for stable transistor operation in the transceiver, and a transient blanker circuit that protects transistors in the transceiver from transient line voltage surges. Two 3/8-ampere fuses in circuits from transformer 2A7T2-11 to diode 2A7CR51 and from transformer 2A7T2-13 to diode 2A7CR52 provide protection against damage resulting from a short circuit in the 130-volt DC circuit.

#### CAUTION

Do not overheat the fuse. Overheating will cause the fuse to be damaged. Do not allow solder buildup to the extent that sleeving will not go over the solder joint.

8-172. The instant the transceiver is turned on, a ground is placed on relay 2A7K4. Relay 2A7K4 will then energize, supplying the 115-volt, 400-HZ, 3-phase input to transformer 2A7T2 for low-voltage operation. When this happens, 28 volts DC from the low-voltage section is applied to time delay relay 2K7 located in the transceiver chassis. After the 30-second time delay, relay 2K7 will apply 28 volts DC to relay 2A7K1 that will operate supplying the 115-volt, 400-HZ, 3-phase input power to transformer 2A7T1 when the transceiver is keyed. Resistors 2A7R1, 2A7R2, and 2A7R3 limit the surge current which flows when relay 2A7K1 is energized. After the initial surge, step start relay 2A7K2 is energized, and the surge limiting resistors are shorted by the contacts of relay 2A7K2.

8-173. 1500-VOLT DC SUPPLY. The 1550-volt DC supply to power amplifier 2A11 is derived from two full-wave rectifier circuits connected to the secondary windings of transformer 2A7T1. One secondary winding and full-wave rectifier circuit provides 400 volts DC while the other provides 1100 volts DC. The negative side of the 1100-volt supply is connected to the positive side of the 400-volt supply to provide 1500 volts between the positive side of the 1100-volt supply and ground.

8-174. 250-VOLT DC SUPPLY. The 250-volt DC supply is tapped from the combination of the two full

rectifier circuits. Overload relay 2A7K3 is placed across the output of the 250-volt DC supply to remove the ground from relays 2A7K1 and 2A7K2 in the event of an overload from the rectifier circuits.

8-175. 130-VOLT DC SUPPLY. The 130-volt DC supply consists of full-wave rectifier circuit 2A7CR51 and 2A7CR52 with resistor 2A7R10, capacitor 2A7C25 and choke 2A7L3 for voltage regulation. Resistor 2A7R36 is a bleeder across the power line.

8-176. 18-VOLT DC REGULATOR. The 18-volt DC voltage regulator is composed of two DC amplifiers, transistors 2A7Q2 and 2A7Q3, and control transistor 2A7Q1. The DC amplifiers closely regulate the control transistor voltage. The input to the DC amplifiers is an error voltage fed back from the regulator output. The emitter voltage of transistor 2A7Q3 is kept constant by zener diode 2A7CR32. The base voltage is derived from a resistive voltage divider that is connected across the regulator output. Thus the emitter-base voltage of transistor 2A7Q3 is proportional to the error in the regulated output voltage. If the output of the regulator is shorted, the regulator will cease operating, for the regulating action is initiated and controlled by the regulator output. When the short occurs, an excessively large current will tend to flow in the output of the regulator. This action will produce a large error voltage across the emitter-base junction of transistor 2A7Q3. Control transistor 2A7Q1 will cut off because of this large error voltage. With transistor 2A7Q1 cut off, current will flow through resistors 2A7R11 and 2A7R17 to maintain a sufficiently large error across the emitter-base junction of transistor 2A7Q3 to keep 2A7Q1 cut off as long as the short exists. Once the short across the regulator output has been removed, the large error voltage across the emitter-base junction of transistor 2A7Q3 will decrease, which in turn causes transistor 2A7Q1 to resume its regulating action.

8-177. TRANSIENT BLANKER CIRCUIT. During operation, high transient voltage peaks may occur on the main electrical line of the aircraft in which the HF Radio Set is installed. These voltage peaks occur when electrical units, such as electric motors, are turned off. This causes voltage peaks on the 28-volt DC line to the transceiver. These peaks are approximately 80 volts DC and return to normal line voltage in approximately 0.5 second. The transient blanker circuit protects the transistors in the transceiver from these voltage surges by reducing the voltage on the 28-volt DC line to approximately 0 for the duration of the surge.

8-178. The transient blanker circuit is identical to the 18-volt DC regulator circuit. Transistors 2A7Q5 and 2A7Q6 are the DC amplifiers, and 2A7Q4 is the control transistor. Zener diode 2A7CR31 is used to keep the emitter voltage of transistor 2A7Q6 constant with base voltage derived from a resistive voltage

divider in the blanker output. The emitter-base voltage of transistor 2A7Q6 will be proportional to any error or voltage transient above +32 volts DC.

8-179. When a voltage transient occurs, an excessively large current will tend to flow in the output of the transient blanker circuit. This action will produce a large error voltage across the emitter-base junction of transistor 2A7Q6, cutting off control transistor 2A7Q4. With transistor 2A7Q4 cut off, current will flow through resistors 2A7R20 and 2A7R29. This will maintain a sufficiently large error across the emitter-base junction of transistor 2A7Q6 to keep 2A7Q4 at cutoff as long as the voltage transient exists. When the voltage transient has dropped back to +32 volts DC, the large error voltage across the emitter-base junction of transistor 2A7Q6 will decrease, which in turn allows transistor 2A7Q4 to assume its regulating action. Thermal switch 2A7S1 will open and deenergize relay 2A7K4 in the event of excessive heating.

#### 8-180. TEST PROCEDURES.

#### 8-181. TEST SETUP.

8-182. Before interconnecting equipment, ensure that all primary power switches are placed in OFF position.

### WARNING

Before connecting the primary power cable to the bench, make sure that a ground strap is connected between the ground lug on the bench and the nearest ground point of the primary power source.

Interconnect test equipment as shown in figure 2-1. Deviations from the test equipment hookup diagram are covered in the test procedures. Test equipment required is listed in figure 3-1.

#### NOTE

Equivalent test equipment may be used.

#### 8-183. INITIAL CONTROL SETTINGS.

8-184. Refer to figure 6-8. Deviations from the initial control settings are covered in the test procedures.

#### 8-185. MODULE TEST PROCEDURE.

8-186. Perform the test procedures of figure 8-38 in the order given.

#### 8-187. TROUBLE ANALYSIS.

8-188. Trouble analysis information is incorporated in the PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY column of figure 8-38.

#### 8-189. DISASSEMBLY.

8-190. Disassembly of power supply 2A7 is self-evident.

#### 8-191. INSPECTION, CLEANING, AND REPAIR.

8-192. Inspection, cleaning, and repair information is contained in section X.

#### 8-193. ASSEMBLY.

8-194. Assembly of power supply 2A7 is self-evident.

#### 8-195. MODIFICATION HISTORY.

8-196. GENERAL. The following paragraph contains the modification history for power supply 2A7. The modification history is arranged by MCN or configuration identifier (CI) effectivity. In some cases, it was not necessary to record the MCN effectivity.

8-197. POWER SUPPLY 2A7. The modification history is as follows:

#### NOTE

Reference designations are abbreviated. Prefix designations with 2A7.

##### a. At MCN 101:

1. Added thermal switch S1.
2. Changed resistor R26 from 1800 to 2700 ohms.
3. Changed resistor R23 from 2000 to 5000 ohms.
4. Changed resistor R5 from 18.2 ohms, 10 watts to 18.2 ohms, 15 watts.
5. Deleted capacitor C27 from relay K3-6 to ground.
6. Added capacitors C27 through C38, and made various circuit changes.

##### b. At MCN 107:

1. Added resistor R37 (10,000 ohms) from connector P1-5 to jack J6.
2. Added capacitor C39 (150 microfarads, 50 volts) from connector P1-5 to ground.
- c. Changed resistor R9 from 8.2 to 4.7 ohms.
- d. Added fuses F1 and F2 at transformer T2-11 and T2-13.
- e. Added capacitors C40 through C45 (0.01 microfarad).
- f. At MCN 656, capacitor C39 was from resistor R37 to ground, now from resistor R20 to ground.
- g. Resistor R5 was from jack J5 to diode CR44; now from jack J5 to switch S1.
- h. At REV LTR H, changed diodes CR1 thru CR30 from 1N547 to 1N4247.

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
1		Initial test requirements	<p>Refer to figure 8-39 for location of all test points on power supply 2A7.</p> <p>Remove power supply 2A7 from radio receiver-transmitter chassis, and perform visual inspection.</p> <p>Remove dust cover from module for this step.</p> <p>Install power supply 2A7 in radio receiver-transmitter chassis.</p> <p>NOTE</p> <p>Unless otherwise specified, all steps are performed with radio set control mode selector set to AM, no signal in, and radio receiver-transmitter unkeyed.</p> <p>Apply 115-volt, 400-HZ, 3-phase primary power to radio set test harness input power cable W20.</p> <p>Apply 115-volt, 60-HZ, single-phase primary power to HVU blower power cable.</p> <p>Position radio set test harness POWER switch to ON.</p> <p>Position radio set control mode selector to AM.</p> <p>NOTE</p> <p>Allow 15 minutes for equipment to warm up.</p> <p><b>WARNING</b></p> <p>Voltages dangerous to life exist in power supply 2A7.</p>	<p>Radio set test harness POWER lamp should light, and radio receiver-transmitter blower should operate.</p> <p><b>CAUTION</b></p> <p>Position POWER switch to OFF immediately if blower does not operate.</p>	<p>Repair or replace faulty POWER lamp and/or blower.</p> <p>NOTE</p> <p>Refer to Radio Set Test Bench AN/ARM-86 (TO 33D7-4-14-1) for repair procedures of faulty equipment contained in AN/ARM-86.</p>
2		+28 volt DC check	Position R/T TEST SWITCH on radio set test harness to 28V position.	R/T TEST METER should indicate 5 ±1 meter increments.	Check primary power source.

Figure 8-38. Module Checks and Adjustments, Power Supply 2A7 (Sheet 1 of 3)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
3		+130 volt DC check	Position R/T TEST SWITCH on radio set test harness to 130V position.	R/T TEST METER should indicate $5 \pm 1$ meter increments.	Check transformer 2A7T2, fuses 2A7F1 and 2A7F2, and diodes 2A7CR51 and 2A7CR52. Replace faulty components as necessary.
4		+1500-volt DC check	Position R/T TEST SWITCH on radio set test harness to 1500-V position.  Position KEY switch on radio set test harness to ON, note reading, and unkey.	R/T TEST METER should indicate $5 \pm 0.5$ meter increments.	Check relays 2A7K1 and 2A7K2, and transformer 2A7T1 and its associated circuit. Replace faulty components as necessary.
5	2A7J2 (F2)	+18 volt DC check	Connect MIL-V-9999 differential voltmeter between test point (F2) and ground in power supply 2A7.	Differential voltmeter should indicate between +17.82 and +18.18 volts DC.	Adjust resistor 2A7R16 to provide required results.
6	2A7J6 (F6)	+25 volt DC check	Connect MIL-V-9999 differential voltmeter between test point (F6) and ground in power supply 2A7.	Differential voltmeter should indicate between +24.75 and +25.25 volts DC.	Adjust resistor 2A7R32 to provide required results.
7	2A7J3 (F3)	+32 volt DC check	Connect MIL-V-9999 differential voltmeter between test point (F3) and ground in power supply 2A7.	Differential voltmeter should indicate between +31.5 and +32.5 volts DC.	Check transformer 2A7T2, diodes 2A7CR35 through 2A7CR40, and capacitors 2A7C40 through 2A7C45. Replace faulty components as necessary.
8	2A7J1 (F1)	+250 volt DC check	Connect HP-140B VTVM between test point (F1) and ground in power supply 2A7.  Position KEY switch on radio set test harness to ON, note reading, and unkey.	VTVM should indicate between +230 and +270 volts DC.	Check relays 2A7K1 and 2A7K2 and transformer 2A7T1 and its associated circuit. Replace faulty components as necessary.

Figure 8-38. Module Checks and Adjustments, Power Supply 2A7 (Sheet 2 of 3)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
9		Overload relay 2A7K3 adjustment	<p>Set mode selector on radio set control to OFF position.</p> <p>Remove power supply 2A7 from radio receiver-transmitter chassis.</p> <p>Using Fluke 407DR power supply, apply +28 volts DC to 2A7P1-18 and ground power supply to 2A7P1-13.</p> <p>Connect Simpson 269 between 2A7P1-15 and (-) terminal of HP-6266B power supply. Set Simpson 269 to 1.6-ampere scale. Connect (+) terminal of power supply to power supply 2A7 chassis.</p> <p>Connect ohmmeter between 2A7P1-26 and 2A7P1-30.</p> <div style="border: 1px solid black; padding: 2px; text-align: center; width: fit-content; margin: 10px auto;"><b>CAUTION</b></div> <p>Perform this test as quickly as possible. Damage to resistor 2A7R5 may result.</p> <p>Adjust HP-6266B power supply voltage until ohmmeter indication increases abruptly to infinity.</p>	<p>0 ohms.</p> <p>Simpson 269 should read between 1.0 and 1.1 ampere.</p>	<p>Adjust resistor 2A7R23 to provide required results.</p> <p style="text-align: center;">NOTE</p> <p>If test must be repeated, turn off Fluke 407DR power supply to reset relays; then repeat test.</p>
10		Disconnect	<p>Turn off power.</p> <p>Disconnect all test equipment.</p> <p>Install power supply 2A7 in radio receiver-transmitter chassis.</p>		

Figure 8-38. Module Checks and Adjustments, Power Supply 2A7 (Sheet 3 of 3)

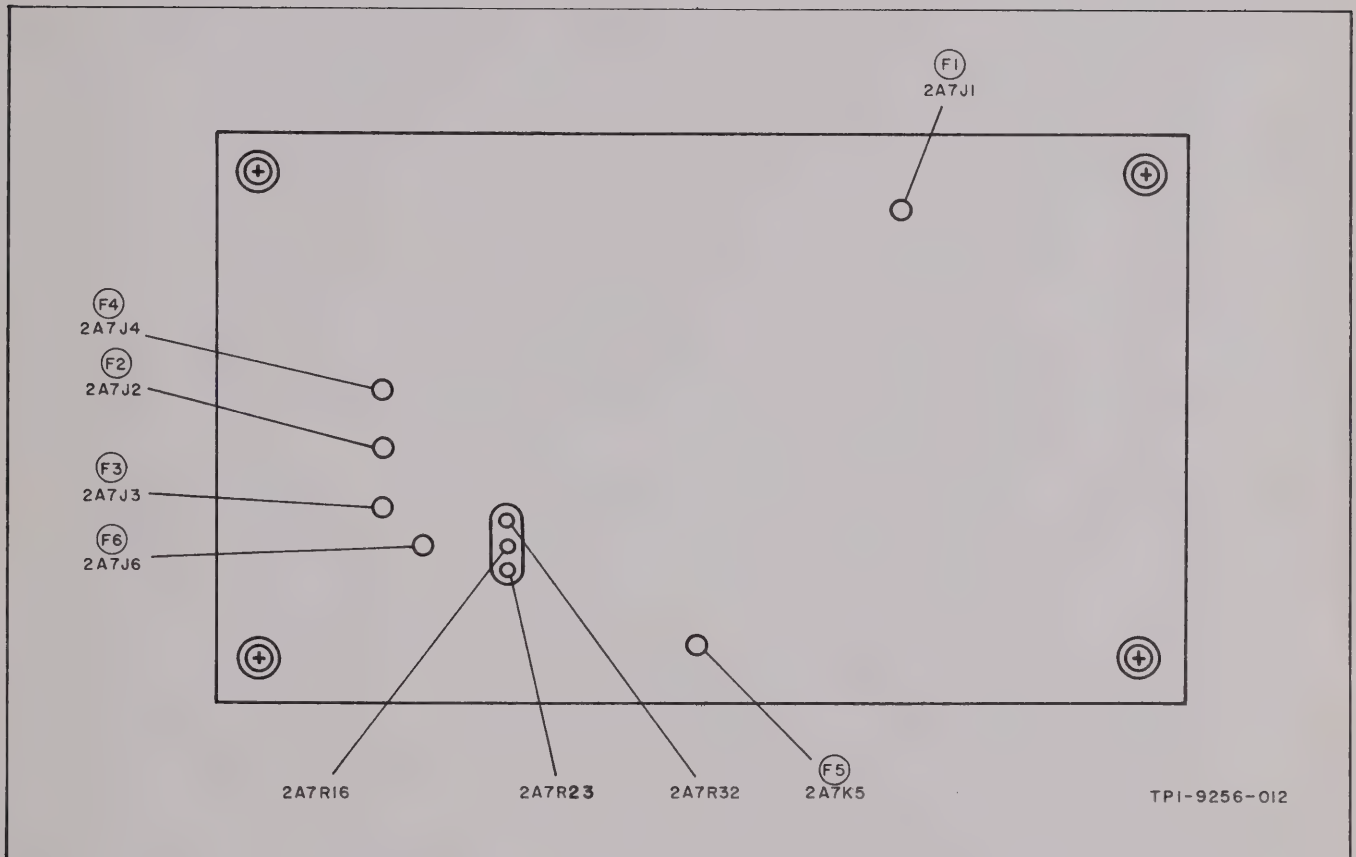
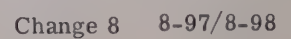


Figure 8-39. Power Supply 2A7, Test-Point and Component Location



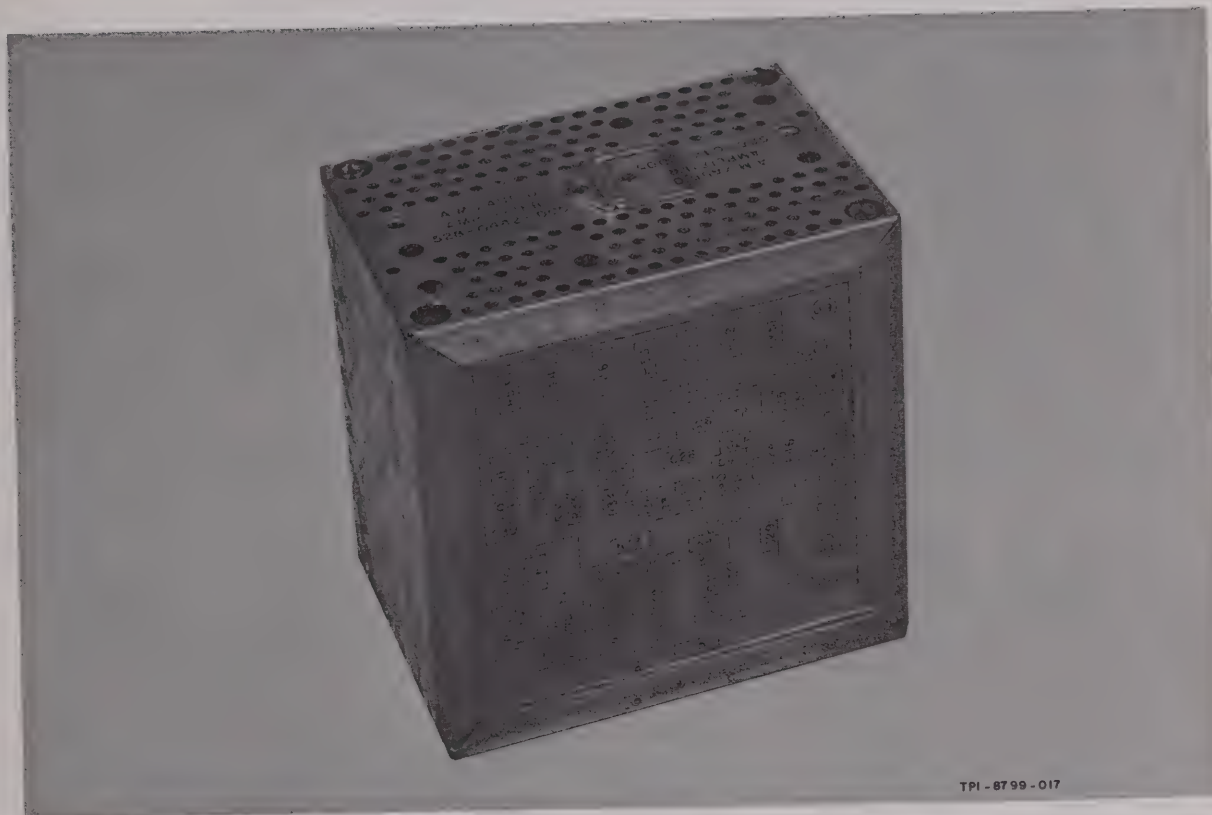


5. REFERENCE DESIGNATIONS ARE ABBREVIATED.  
PREFIX DESIGNATIONS WITH UNIT AND MODULE  
REFERENCE DESIGNATION.



**2A9**

**AM/AUDIO AMPLIFIER  
THEORY AND MAINTENANCE**



**AM/AUDIO AMPLIFIER 2A9**

**Paragraph Number**

CIRCUIT ANALYSIS	8-199
TEST PROCEDURES	8-203
TEST SETUP	8-204
INITIAL CONTROL SETTINGS	8-206
MODULE TEST PROCEDURE	8-208
TROUBLE ANALYSIS	8-210
DISASSEMBLY	8-212
INSPECTION, CLEANING, AND REPAIR	8-214
ASSEMBLY	8-216
MODIFICATION HISTORY	8-218

Figure 8-41. AM/Audio Amplifier 2A9, Maintenance Marker

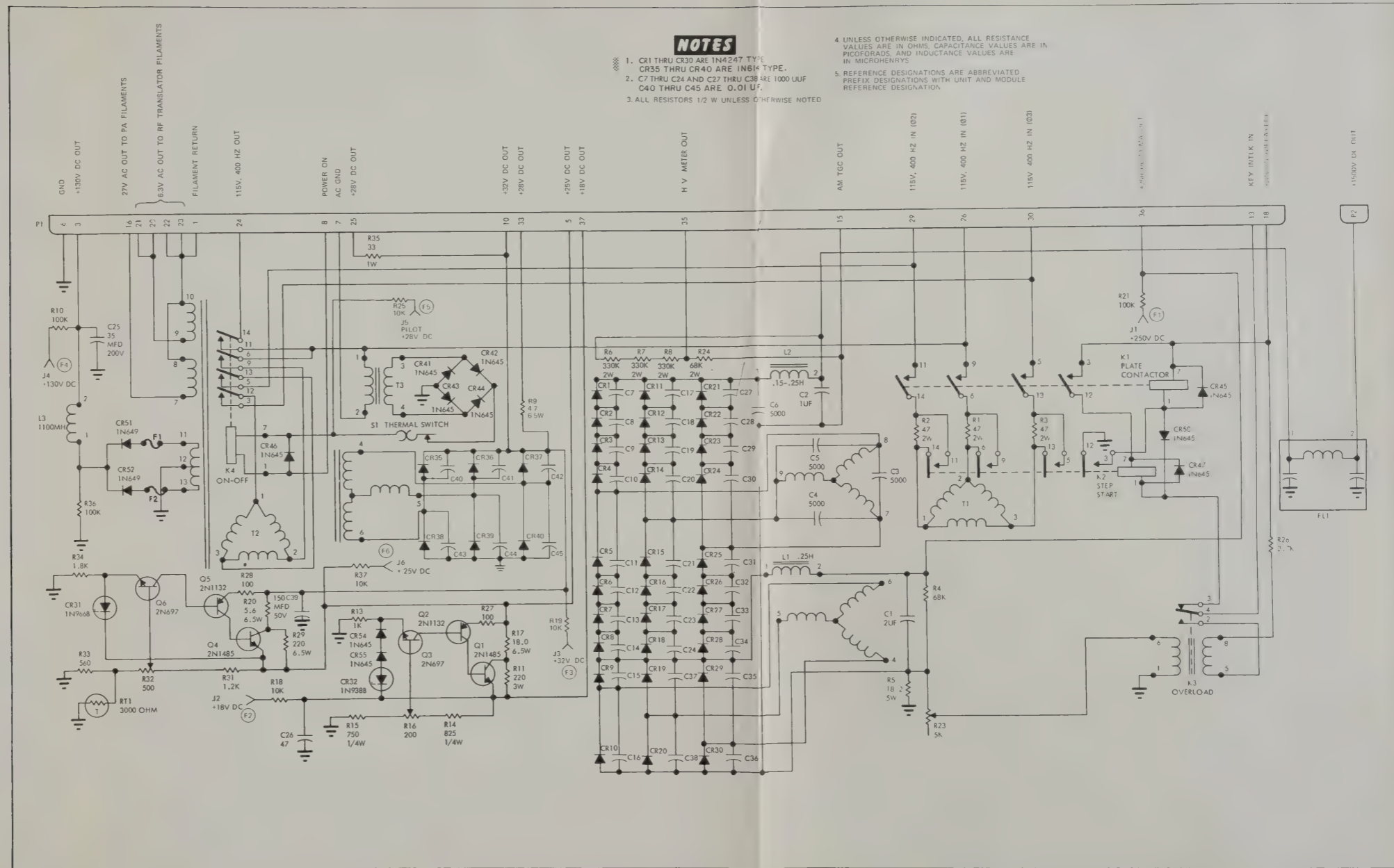
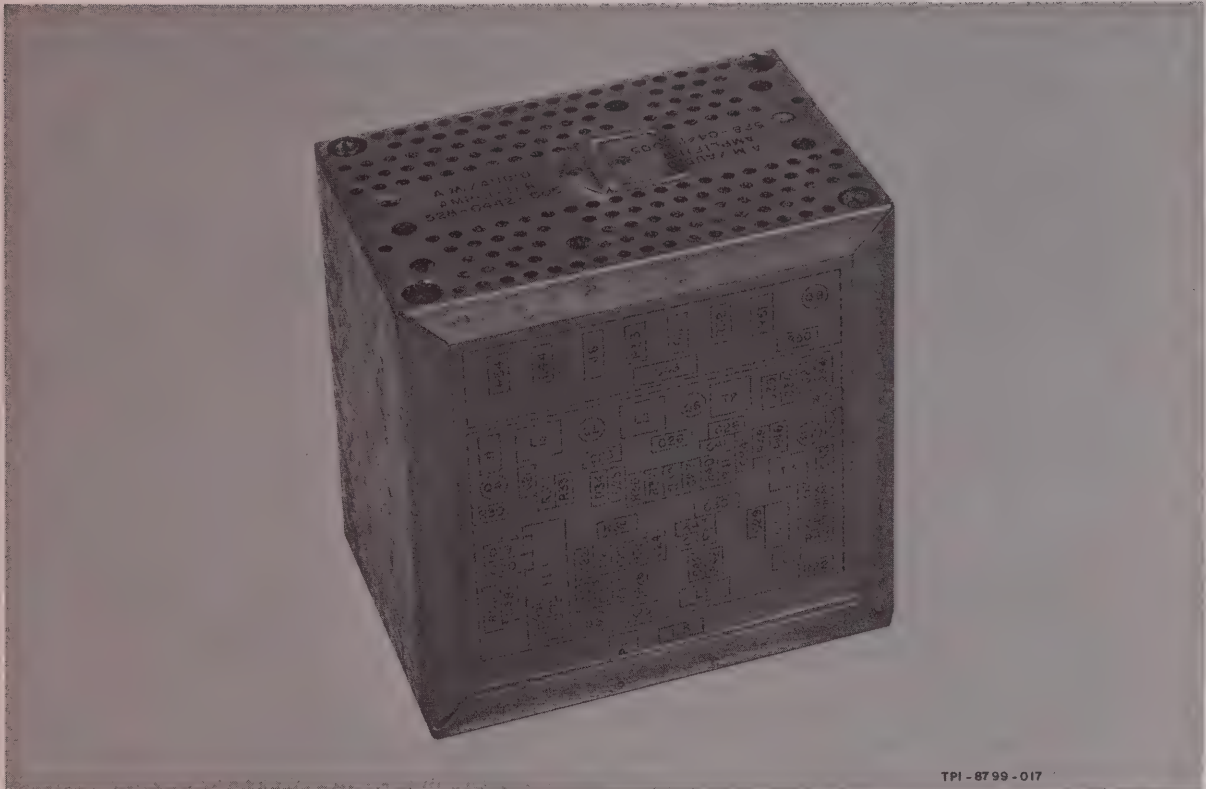


Figure 8-40. Power Supply 2A7, Schematic Diagram

**2A9**

**AM/AUDIO AMPLIFIER  
THEORY AND MAINTENANCE**



TPI-8799-017

**AM/AUDIO AMPLIFIER 2A9**

**Paragraph Number**

CIRCUIT ANALYSIS	8-199
TEST PROCEDURES	8-203
TEST SETUP	8-204
INITIAL CONTROL SETTINGS	8-206
MODULE TEST PROCEDURE	8-208
TROUBLE ANALYSIS	8-210
DISASSEMBLY	8-212
INSPECTION, CLEANING, AND REPAIR	8-214
ASSEMBLY	8-216
MODIFICATION HISTORY	8-218

Figure 8-41. AM/Audio Amplifier 2A9, Maintenance Marker

### 8-198. AM/AUDIO AMPLIFIER 2A9.

#### 8-199. CIRCUIT ANALYSIS.

8-200. GENERAL. AM/audio amplifier 2A9 functions during both the transmit and receive operation of the HF Radio Set. It provides audio amplification, AGC (automatic gain control), and IF amplification for received signals when the HF Radio Set operates in the AM mode.

8-201. RECEIVE FUNCTION. (Refer to figures 8-42, 8-43, and 8-46). In receive operation, IF amplifiers 2A9Q3 through 2A9Q6 operate continuously. A 500-KHZ IF input signal from rft translator 2A12 is applied through IF amplifier 2A9Q3 to 6-KHZ mechanical filter 2A9FL1. Filter 2A9FL1 is capable of passing both audio sidebands. The output of 6-KHZ mechanical filter 2A9FL1 is applied through IF amplifiers 2A9Q4, 2A9Q5, and 2A9Q6 to AM detector 2A9CR4. The audio output of AM detector 2A9CR4 is applied to audio amplifier 2A9Q8 through the action of AM/sideband switching relay 2A3K3. The output of audio amplifier 2A9Q8 is further amplified by audio amplifiers 2A9Q1 and 2A9Q2 and applied to the headsets. A portion of the output of IF amplifier 2A9Q6 is applied to AGC amplifier 2A9Q7, then rectified, filtered, and applied to IF amplifiers 2A9Q3 and 2A9Q4 for automatic gain control. A portion of this AGC is also applied to IF amplifiers 2A2Q2 and 2A3Q3.

8-202. TRANSMIT FUNCTION. In transmit operation, AM/audio amplifier 2A9 receives a microphone input signal on the unbalanced line. The input signal is amplified in audio amplifiers 2A9Q1 and 2A9Q2 and coupled to the balanced modulator in IF translator 2A3. The energization of relay 2A9K1 causes a 1-KHZ tune tone (from frequency divider 2A1) to be applied to audio amplifier 2A9Q8 while the antenna coupler is tuning. The 2A9 module also provides 1.5 volts DC on the microphone line for excitation of carbon microphones.

#### 8-203. TEST PROCEDURES.

#### 8-204. TEST SETUP.

8-205. Before interconnecting equipment, ensure that all primary power switches are placed in OFF position.

### WARNING

Before connecting the primary power cable to the bench, make sure that a ground strap is connected between the ground lug on the bench and the nearest ground point of the primary power source.

Interconnect test equipment as shown in figure 2-1. Deviations from the test equipment hookup diagram are covered in the test procedures. Test equipment required is listed in figure 3-1.

### NOTE

Equivalent test equipment may be used.

#### 8-206. INITIAL CONTROL SETTINGS.

8-207. Refer to figure 6-8. Deviations from the initial control settings are covered in the test procedures.

#### 8-208. MODULE TEST PROCEDURE.

8-209. Perform the test procedures of figure 8-44 in the order given.

#### 8-210. TROUBLE ANALYSIS.

8-211. Trouble analysis information is incorporated in the PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY column of figure 8-44.

#### 8-212. DISASSEMBLY.

8-213. Disassembly of AM/audio amplifier 2A9 is self-evident.

#### 8-214. INSPECTION, CLEANING, AND REPAIR.

8-215. Inspection, cleaning, and repair information is contained in section X.

#### 8-216. ASSEMBLY.

8-217. Assembly of AM/audio amplifier 2A9 is self-evident.

#### 8-218. MODIFICATION HISTORY.

8-219. GENERAL. The following paragraph contains the modification history of AM/audio amplifier 2A9. The history is arranged by MCN or configuration identifier (CI) effectivity. In some cases, it was not necessary to record the MCN effectivity.

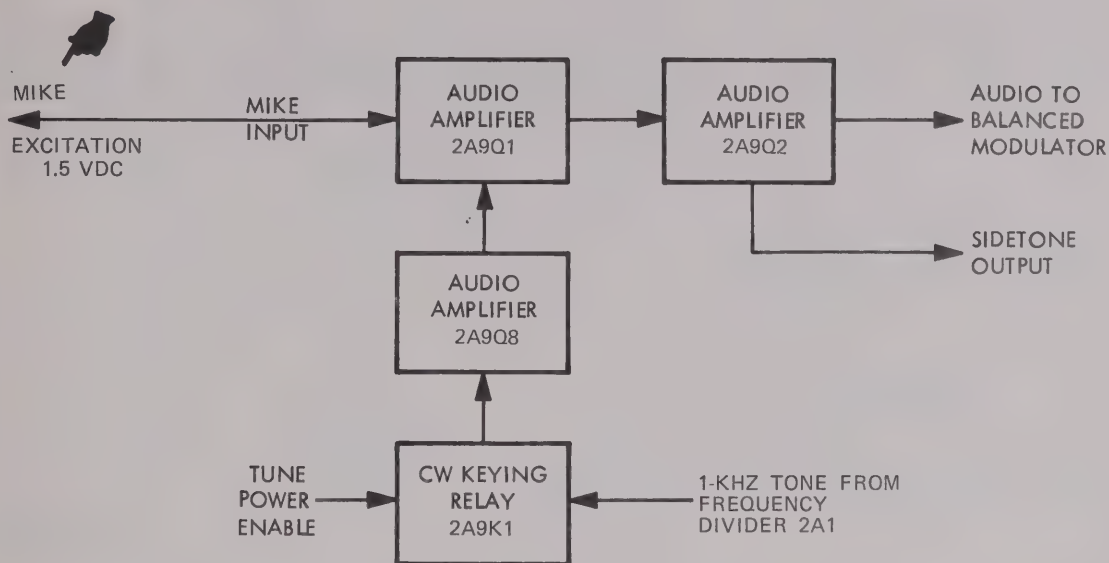
8-220. AM/AUDIO AMPLIFIER 2A9. The modification history is as follows:

### NOTE

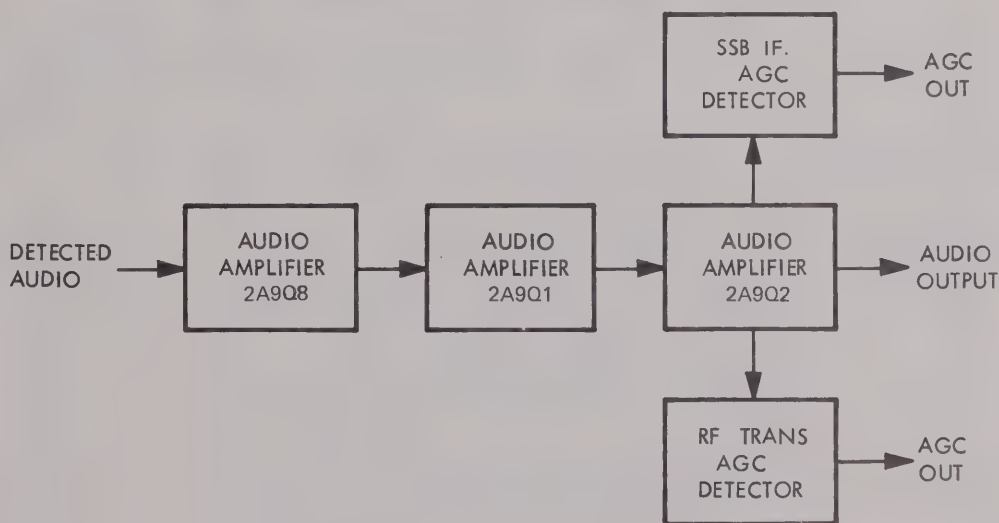
Reference designations are abbreviated. Prefix designation with 2A9.

- a. Changed capacitor C2 from 15 to 10 microfarads.
- b. Changed capacitor C6 from 0.68 to 0.33 microfarad.
- c. Changed diodes CR2, CR4 through CR7, and CR11 from 1N198 to JAN 1N933.
- d. Changed diode CR13 from SZ885 to 1N4122.
- e. Changed resistor R57 from 6800 to 22,000 ohms.
- f. At MCN 731:
  1. Changed transistors Q3 through Q7 from 2N274 to 2N2188.
  2. Changed resistor R41 from 22,000 to 33,000 ohms.
- g. At MCN 1222, replaced coil L9 with 27-ohm resistor R59.
- h. At REV LTR M:
  1. Changed Q3 thru Q6 from 2N2188 to 2N3135.
  2. Changed Q7 from 2N274 to 2N3135.
- i. At REV LTR P, changed R48 from 2200 to 1800 ohms.
- j. At REV LTR R, changed R10 from 5.6 to 4.7 ohms.
- k. At CI 75204, changed C52 from 0.02 to 0.022 microfarad.

### TRANSMIT



### RECEIVE



F4JM/HFC-51

Figure 8-42. Audio Amplifier Stages in AM/Audio Amplifier 2A9, Block Diagram

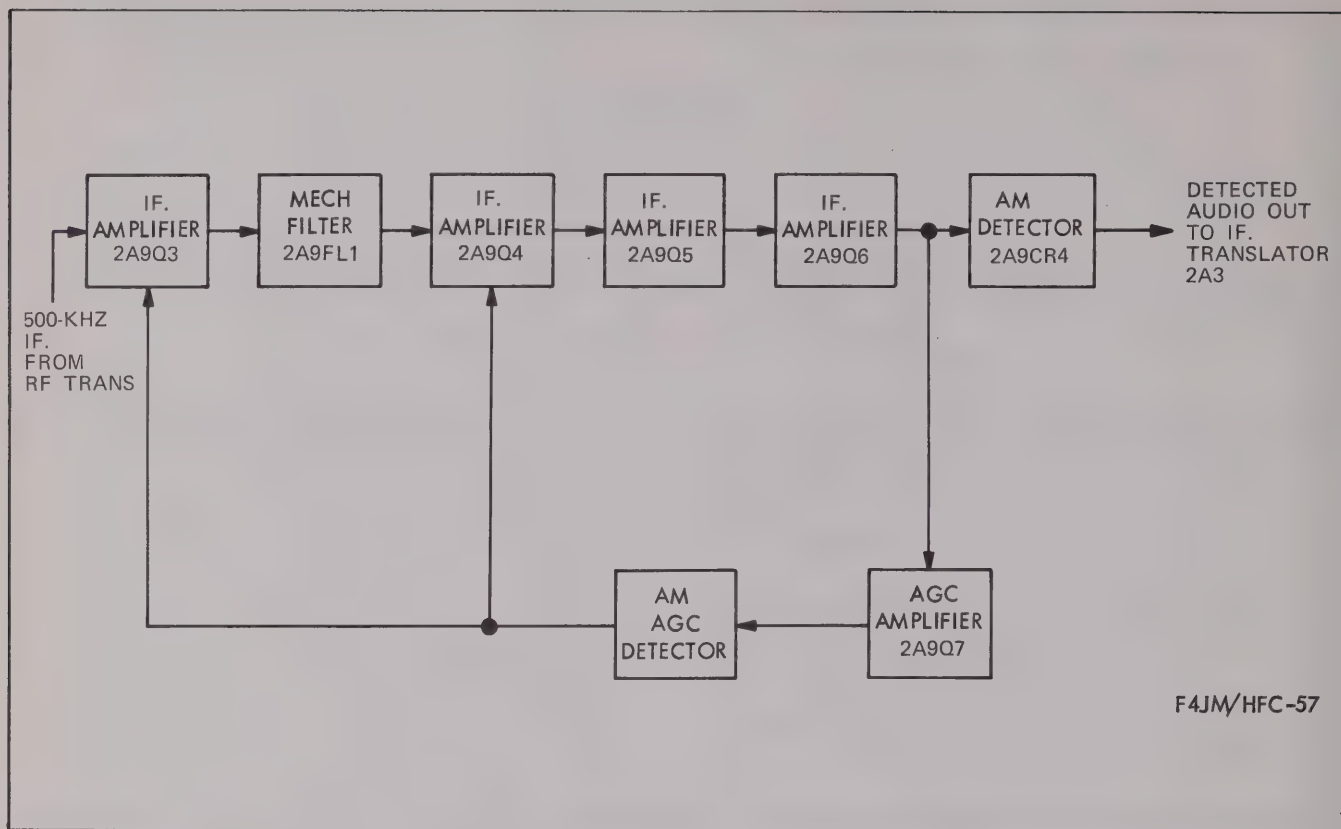


Figure 8-43. AM/Audio Amplifier 2A9, Block Diagram

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
1		Initial test requirements	<p>Refer to figure 8-45 for location of all test points on AM/audio amplifier 2A9.</p> <p>Remove AM/audio amplifier 2A9 from radio receiver-transmitter chassis, and perform visual inspection.</p> <p>Remove dust cover from module to perform this test procedure.</p> <p>Connect AM/audio amplifier 2A9 through module extender to radio receiver-transmitter chassis.</p> <p style="text-align: center;">NOTE</p> <p>Unless otherwise specified, all steps are performed with radio set control mode selector set to AM, no signal in, and radio receiver-transmitter unkeyed.</p>		
(Cont)					

Figure 8-44. AM/Audio Amplifier 2A9, Module Checks and Adjustments (Sheet 1 of 4)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
1 (Cont)			<p>Apply 115-volt, 400-HZ, 3-phase primary power to radio set test harness input power cable W20.</p> <p>Apply 115-volt, 60-HZ, single-phase primary power to HVU blower power cable.</p> <p>Position radio set test harness POWER switch to ON.</p> <p>Position radio set control mode selector to AM.</p> <p style="text-align: center;">NOTE</p> <p>Allow 15 minutes for equipment to warm up.</p>	<p>Radio set test harness POWER lamp should light, and radio receiver-transmitter blower should operate.</p> <div style="border: 1px solid black; padding: 5px; text-align: center; margin: 10px 0;"> <b>CAUTION</b> </div> <p>Position POWER switch to OFF immediately if blower does not operate.</p>	<p>Repair or replace faulty POWER lamp and/or blower.</p> <p style="text-align: center;">NOTE</p> <p>Refer to Radio Set Test Bench AN/ARM-86 (TO 33D7-4-14-1) for repair procedures of faulty equipment contained in AN/ARM-86.</p>
2	2A9J1 (G1)	IF AGC voltage check	<p>Connect HP-410B VTVM DC probe to test point (G1).</p> <p>Check voltage at test point (G1).</p> <p>Disconnect HP-410B.</p>	Not less than +5 VDC.	Check A9Q7 and associated circuit.
3  (Cont)	  2A9J4 (G4)	Audio amplifier gain adjustment	<p>Connect HP-400D AC VTVM to function test set TEST POINT jack.</p> <p>Connect audio oscillator to function test set NO. 1 AUDIO IN with output set at minimum.</p> <p>Connect function test set AUDIO OUT jack to radio set test harness MIKE input.</p> <p>Key radio receiver-transmitter.</p> <p>Set audio oscillator output level to 0.25 V at 1 KHZ as measured at function test set TEST POINT jack.</p> <p>Connect HP-400D AC VTVM to test point (G4).</p>		

Figure 8-44. AM/Audio Amplifier 2A9, Module Checks and Adjustments (Sheet 2 of 4)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
3 (Cont)	2A9J4 (G4)		<p>Check voltage at test point (G4).</p> <p>Recheck voltage at function test set TEST POINT jack with HP-400D AC VTVM.</p> <p>Disconnect AC VTVM and audio oscillator.</p> <p>Connect audio oscillator 600-ohm balanced output to TP15 and TP16 on module extender.</p> <p>Connect HP-410B VTVM across audio oscillator output.</p> <p>Key radio receiver-transmitter.</p> <p>Set audio oscillator output to 1 KHZ, 0.78 VRMS (as indicated on VTVM).</p> <p>Connect HP-400D AC VTVM to test point (G4).</p> <p>Check voltage at test point (G4).</p> <p>Check audio oscillator output voltage (as indicated on HP-140B VTVM).</p> <p>Disconnect HP-410B VTVM and audio oscillator.</p>	<p>8.0 volts RMS.</p> <p>0.25 V with correct voltage at test point (G4).</p> <p>8.0 volts RMS</p> <p>0.78 VRMS with correct voltage at test point (G4).</p>	<p>Adjust 2A9R6.</p> <p>2A9Q1, 2A9Q2, and associated circuits.</p> <p>Incorrect adjustment. Repeat entire step.</p> <p>Adjust 2A9R5.</p> <p>Incorrect adjustment. Repeat entire step.</p>
4  (Cont)		AM receive IF alignment	<p>Connect HP-400D AC VTVM to radio set test harness HEADSET jack.</p> <p>Set radio set control mode selector to AM.</p> <p>Set radio receiver-transmitter AUDIO control fully clockwise.</p> <p>Remove RF translator 2A12 from radio receiver-transmitter chassis.</p> <p>Connect signal generator, through 6-DB attenuator, to radio receiver-transmitter chassis connector 2J38.</p> <p>Set signal generator output to 500 KHZ, 30% modulated with 1 KHZ.</p> <p>Adjust signal generator output level for 2 to 3 VRMS at HEADSET jack. Adjust 2A9C18, 2A9C19, 2A9L2, 2A9L3, 2A9T2 to peak voltage at radio set test harness HEADSET jack.</p>		

Figure 8-44. AM/Audio Amplifier 2A9, Module Checks and Adjustments (Sheet 3 of 4)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
4 (Cont)			<p>Increase signal generator output level to 300 UV.</p> <p>Adjust 2A9T3 to null voltage at radio set test harness HEADSET jack.</p> <p>Adjust signal generator output level for 5.0 VRMS at radio set test harness HEADSET jack.</p> <p>Note signal generator output level.</p> <p>Disconnect VTVM and signal generator.</p>	Between 100 and 200 UV.	Replace 2A9R56 with a resistor selected from complement listed in illustrated parts breakdown (TO 12R2-2ARC105-14).
5		Disconnect	<p>Reset radio receiver-transmitter AUDIO control according to procedure of step 4A of figure 6-9.</p> <p>Turn off power.</p> <p>Disconnect all test equipment.</p> <p>Remove 2A9 from module extender.</p> <p>Remove module extender from radio receiver-transmitter chassis.</p> <p>Replace dust cover on 2A9.</p> <p>Replace 2A9 and 2A12 in radio receiver-transmitter chassis.</p>		

Figure 8-44. AM/Audio Amplifier 2A9, Module Checks and Adjustments (Sheet 4 of 4)

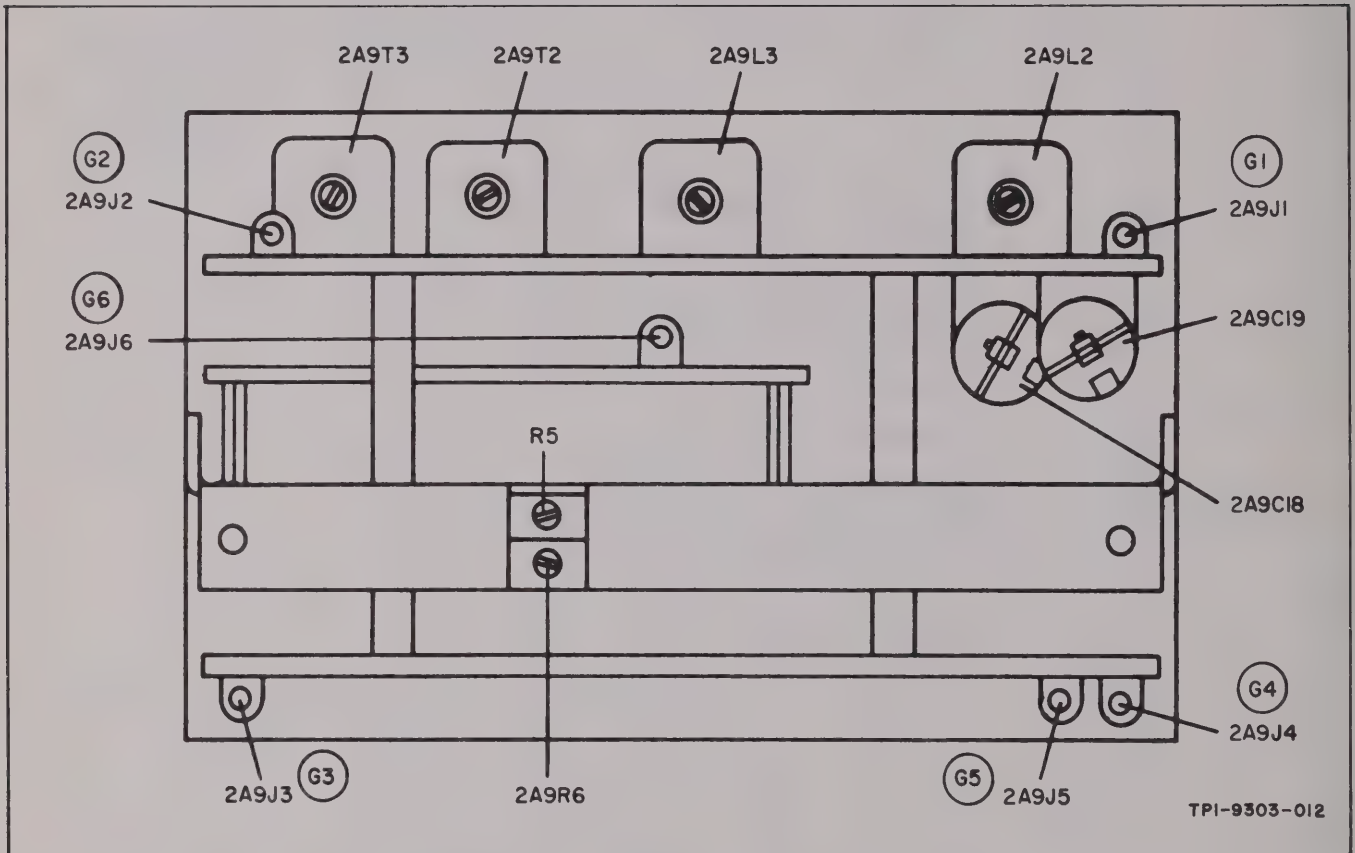


Figure 8-45. AM/Audio Amplifier 2A9, Test-Point and Component Location

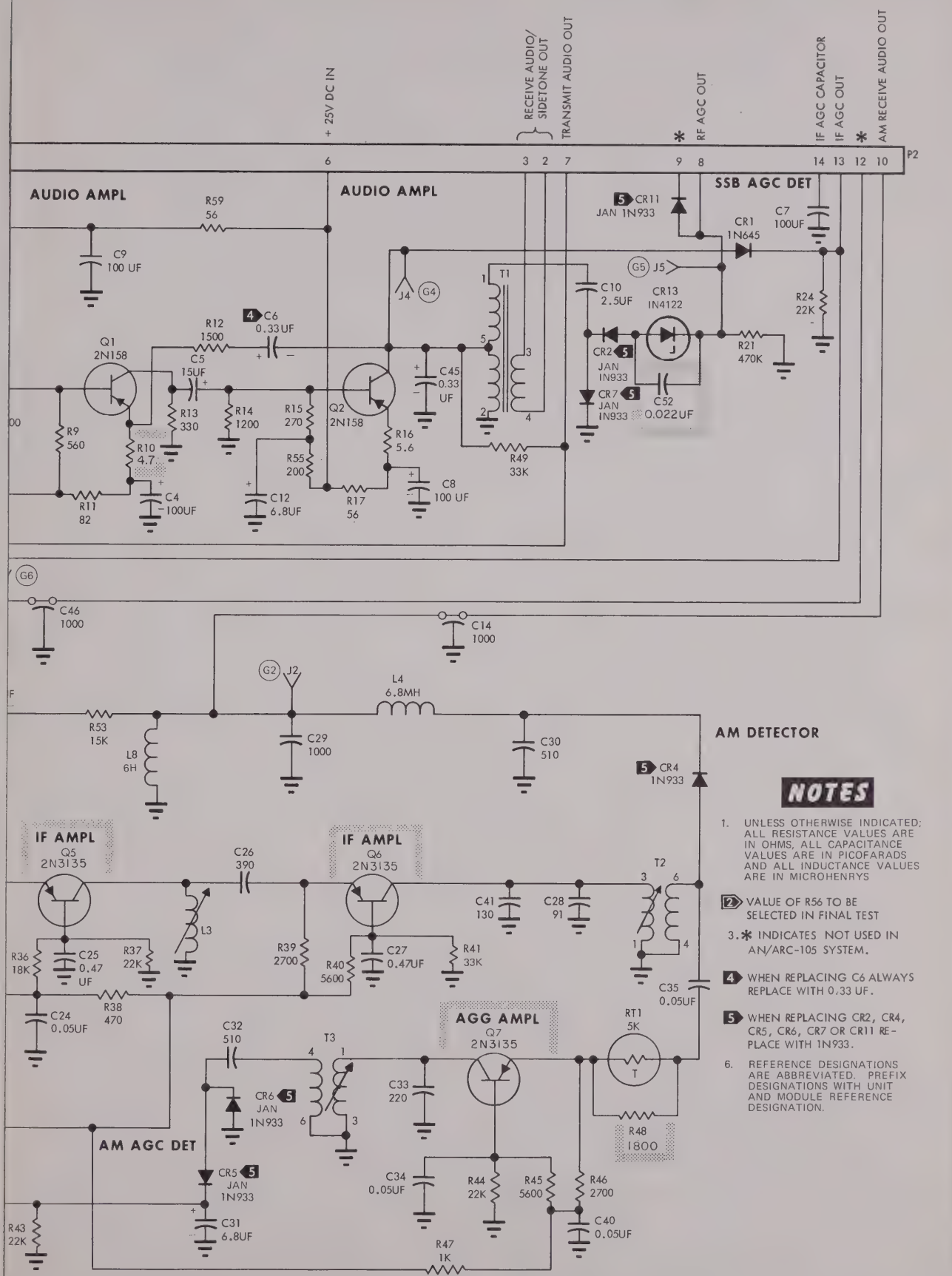


Figure 8-46. AM/Audio Amplifier 2A9, Schematic Diagram

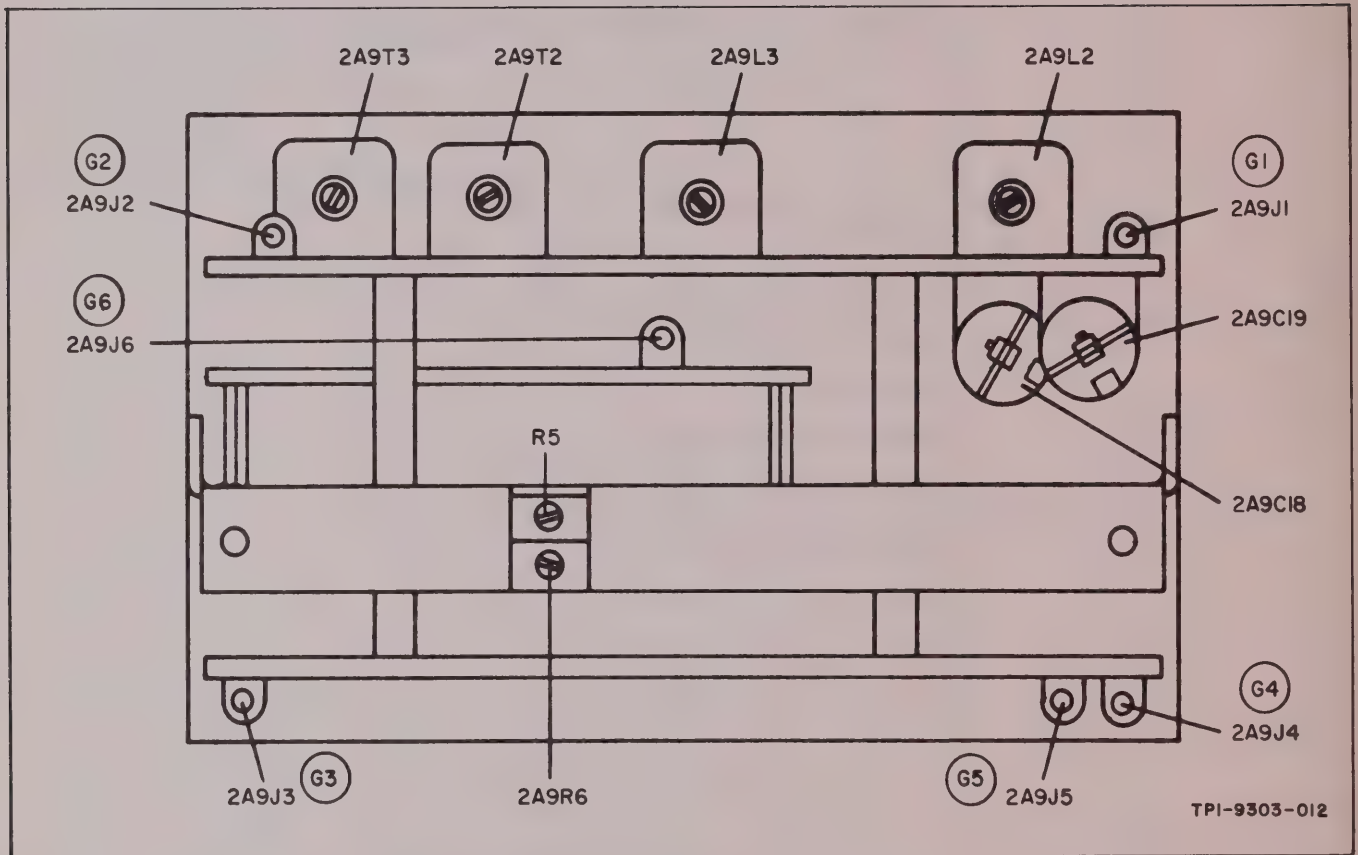


Figure 8-45. AM/Audio Amplifier 2A9, Test-Point and Component Location

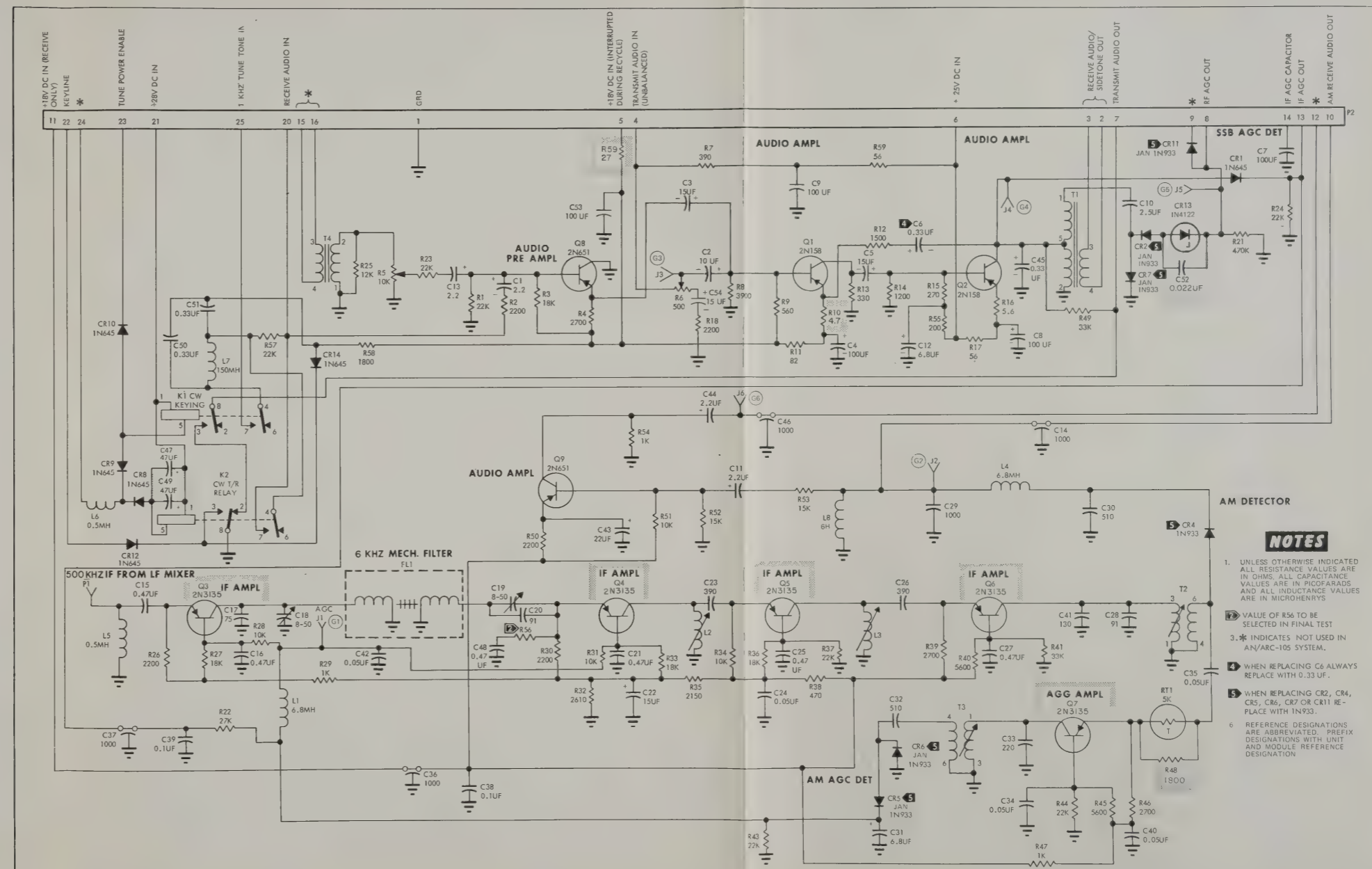
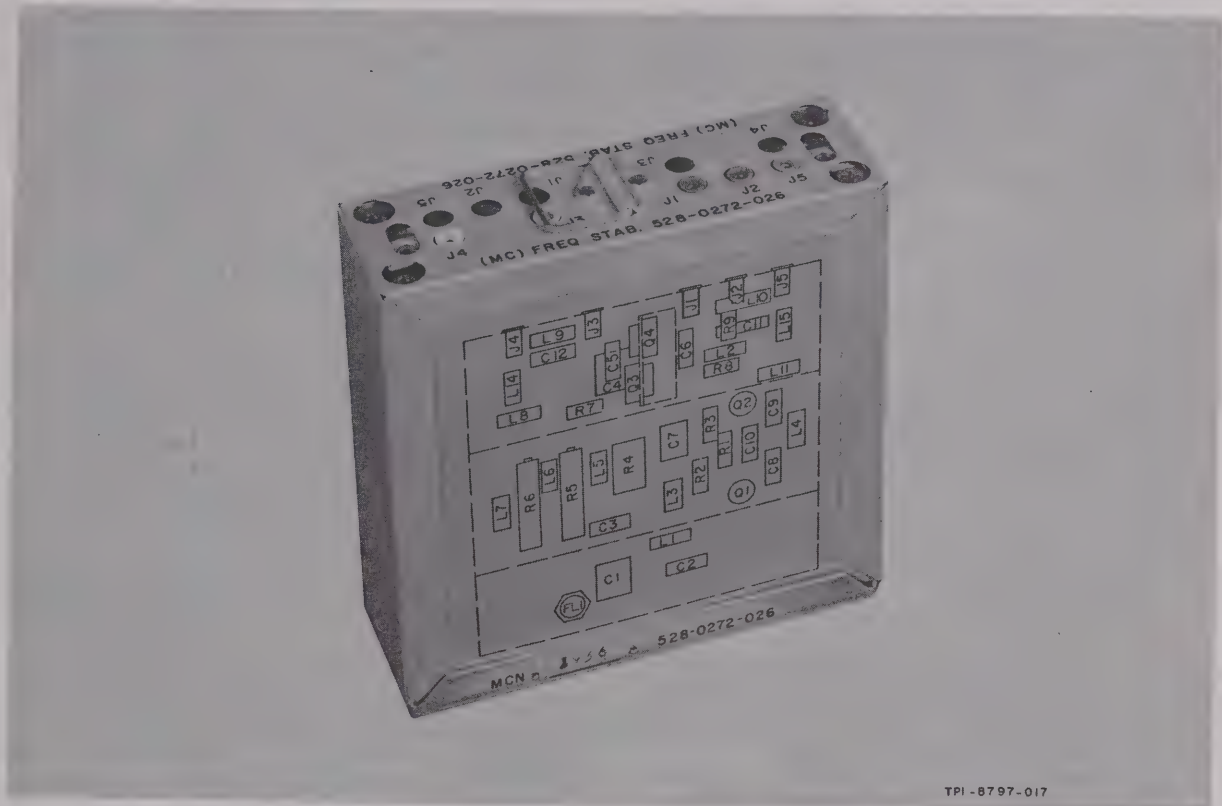


Figure 8-46. AM/Audio Amplifier 2A9, Schematic Diagram



## 2A10

### MC FREQUENCY STABILIZER THEORY AND MAINTENANCE



TPI-8797-017

MC FREQUENCY STABILIZER 2A10

CIRCUIT ANALYSIS	8-222
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INITIAL CONTROL SETTINGS	8-237
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ASSEMBLY	8-247
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#### Paragraph Number

Figure 8-47. MC Frequency Stabilizer 2A10, Maintenance Marker

### 8-221. MC FREQUENCY STABILIZER 2A10.

#### 8-222. CIRCUIT ANALYSIS.

8-223. GENERAL. MC frequency stabilizer 2A10 is an automatic frequency control device that maintains the 17.5- and the 8.5- to 16-MHZ HF oscillators, located in RF transistor 2A12, within a close tolerance of their required operating frequencies. The module generates error-control voltages proportional to the sensed frequency drift of the oscillators and applies these voltages to circuit elements within the oscillator circuits which act to correct the frequency error. MC frequency stabilizer 2A10 is comprised of two duplicate amplifier subassemblies 2A10A1 and 2A10A2 and a spectrum generator. The following discussion describes the action that stabilizes the 17.5-MHZ oscillator. The theory also applies to each of the 16 HF oscillator frequencies.

8-224. CIRCUIT ANALYSIS. (Refer to figures 8-48 and 8-53.) MC frequency stabilizer 2A10 is part of a feedback loop between the oscillator output and the DC tuning voltage input to a voltage-variable capacitor in the oscillator tuned circuit. This module continually compares the oscillator output frequency with a reference frequency and sends out a DC tuning voltage that tunes the oscillator until it is phase-locked with the reference. If the oscillator tends to drift out of phase lock with the reference, MC frequency stabilizer 2A10 will sense this change and correct the oscillator tuning voltage to keep the oscillator phase-locked with the reference at all times.

8-225. The term phase-locked is used because it is possible for two frequencies to be exactly the same and still not be in phase, as shown in figure 8-49. The two frequencies, A and B, are the same but differ by the phase angle ( $\phi$ ). In the figure, A leads B by approximately 90 degrees. The rotating vector, or phasor, representation of the frequencies is also shown. The phasors rotate counterclockwise at the same frequency, A leading B by approximately 90 degrees.

8-226. The 17.5-MHZ oscillator output frequency is applied to the input of MC frequency stabilizer 2A10. In this module, the output frequency passes through two amplifier stages to the input of a mixer. The other mixer input is a 500-KHZ reference pulse. The spectrum of this pulse is a series of reference frequencies, equally spaced at 500-KHZ intervals from 500 KHZ to approximately 25 MHz. Each of these spectrum frequencies is a harmonic of the 500-KHZ reference pulse, so each is as accurate and stable as the reference.

8-227. The mixer output is tuned to 1 MHz. When the 17.5-MHZ oscillator is phase-locked with the reference spectrum frequencies, the mixer output will be a 1-MHZ signal that is a combination of three separate 1-MHZ components. These three 1-MHZ

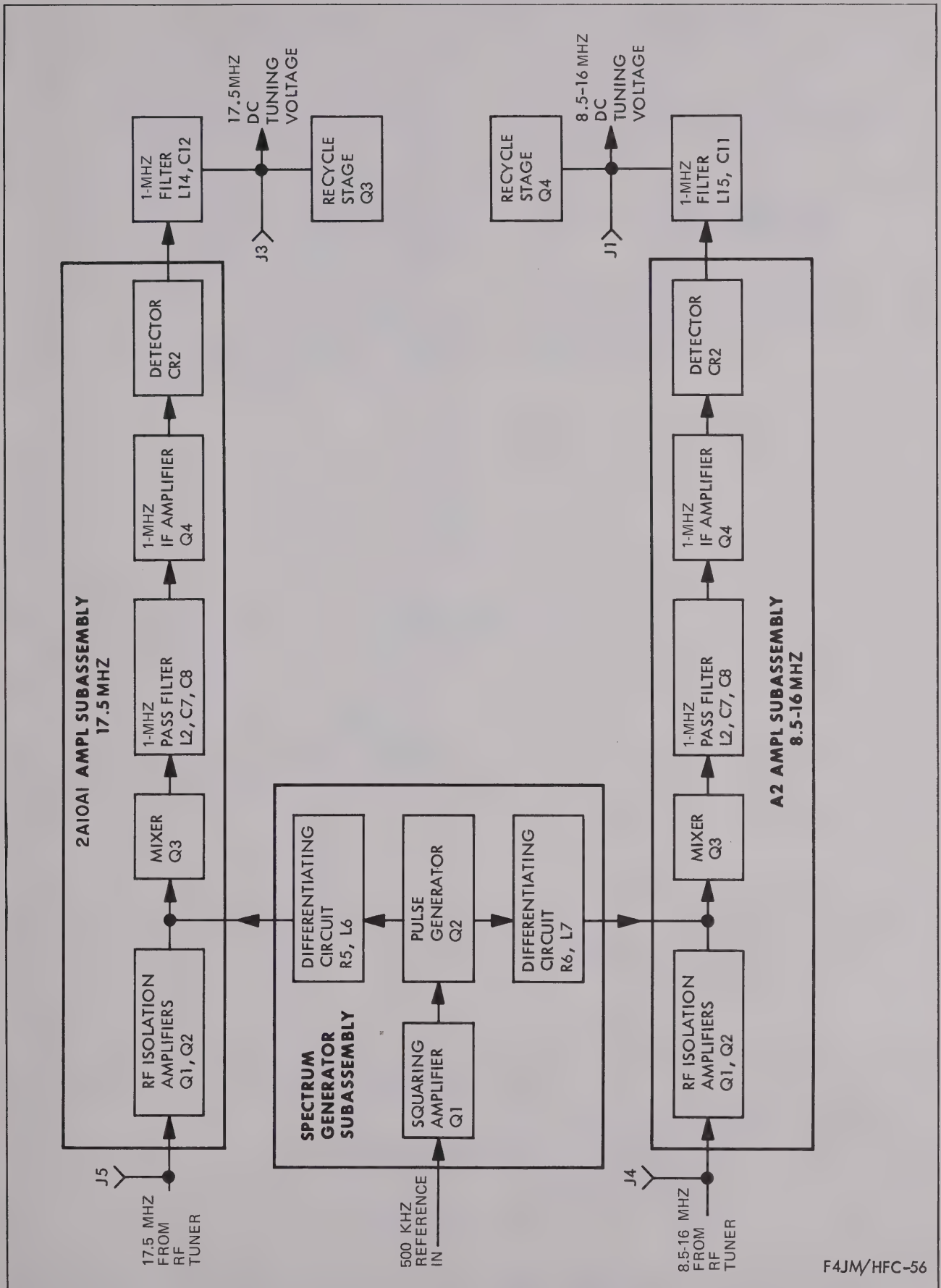
components are the 1-MHZ component of the reference spectrum; the mixer product that is the difference between the 17.5-MHZ oscillator frequency and the 18.5-MHZ reference spectrum component 1 MHz above it; and the mixer product that is the difference between the the 17.5-MHZ oscillator frequency and the 16.5-MHZ reference spectrum component 1 MHz below it.

8-228. (Refer to figure 8-50.) This figure is a phasor representation of the three 1-MHZ mixer-output components. The 1-MHZ reference frequency is represented by a vertical phasor that is rotating counterclockwise at a 1-MHZ rate. The two mixer products are represented by the two phasors approximately 90 degrees out of phase with the reference. These two signal phasors always lead and lag the reference by equal angles for the reason shown below. If the oscillator frequency, for example, leads the reference frequency by phase angle ( $\phi$ ), one mixer product will be  $18.5 - (17.5 + \phi) = 1.0 - \phi$ , and the other mixer product will be  $(17.5 + \phi) - 16.5 = 1.0 + \phi$ . Thus, the two phasors are at equal angles to the reference, one leading and one lagging.

8-229. If the oscillator is phase-locked with the reference, the three phasors are all rotating at exactly the same frequency, and the sum of these three 1-MHZ components will be a single 1-MHZ frequency represented by a vertical phasor that is in phase with the reference phasor. This 1-MHZ signal is amplified and detected by a 1-MHZ IF amplifier. This detected output is a DC voltage that is fed back to a voltage-variable capacitor in the oscillator tuned circuit. Thus, the feedback loop is complete.

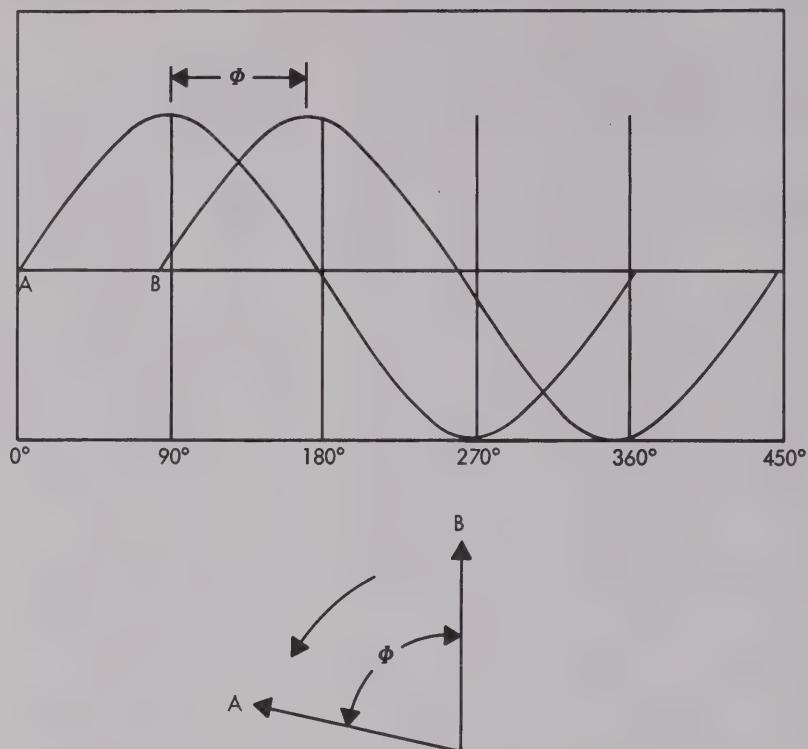
8-230. The phase-locked state of the oscillator is an equilibrium point for the feedback circuit. If either the tuning voltage or oscillator frequency changes, the other will change to compensate for the original change, keeping the oscillator and reference frequencies phase-locked at all times. If, for example, the oscillator frequency drifts with respect to the reference, the phase angle between the signal and the reference frequencies will change. As this angle changes, the signal phasors will shift position and cause the length of the sum phasor to change. Since the DC tuning voltage is obtained by rectifying the AC voltage represented by the sum phasor, the tuning voltage is proportional to the length of the sum phasor and will also change. This change in tuning voltage will keep the oscillator and reference phase-locked.

8-231. The length of the sum phasor, however, is limited to a value determined by the length of the three component phasors. If the frequency drift is great enough to cause the signal phasors to drift into phase with the reference, this limiting value will be reached, the tuning voltage can no longer change, and the oscillator will drift out of lock with the reference. To eliminate this problem, the tuning-voltage output of MC frequency stabilizer 2A10 is applied across a capacitor connected to the input of the unijunction transistor. When the oscillator frequency drifts so



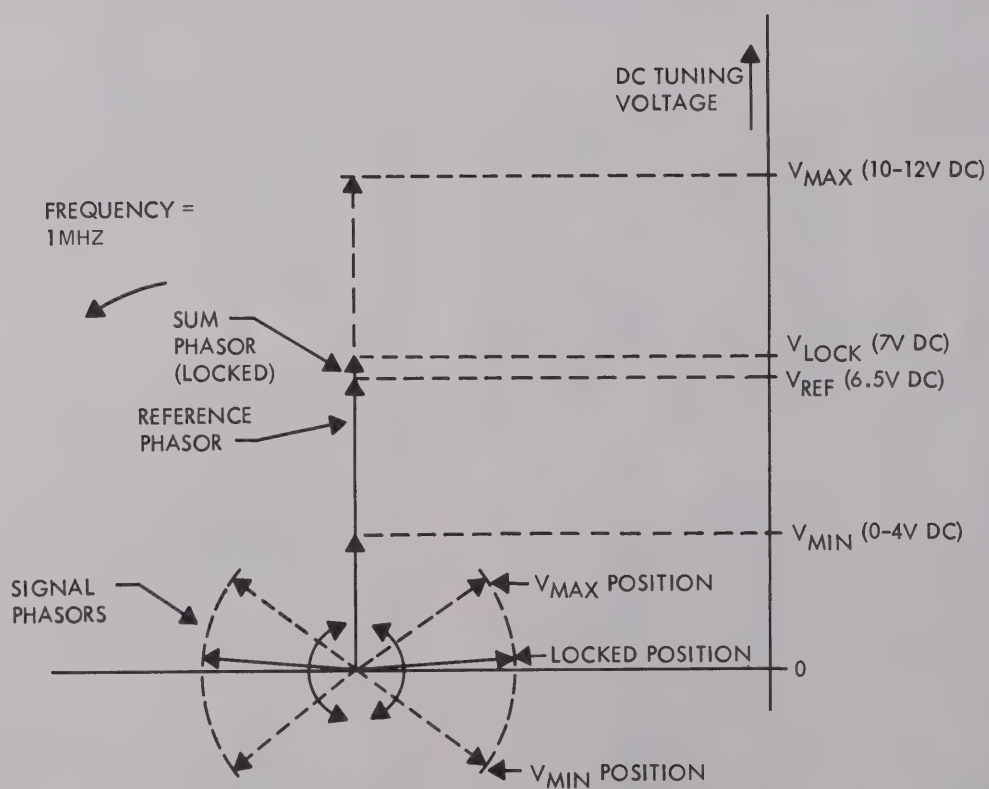
F4JM/HFC-56

Figure 8-48. MC Frequency Stabilizer 2A10, Block Diagram



F4JM/HFC-63

Figure 8-49. Phase Relationships



F4JM/HFC-62

Figure 8-50. Mixer Output Phasors

that the angle between the reference and signal phasors places the signal phasors at the  $V_{MAX}$  position, the sum vector will become long enough to produce a tuning voltage ( $V_{MAX}$ ) that equals the unijunction conduction voltage. When this happens, the capacitor will be shorted, and the tuning voltage will be quickly reduced to a low value. This tuning-voltage change will abruptly retune the oscillator and cause the signal phasors to be repositioned to the  $V_{MIN}$  position. As the capacitors begin to recharge, the tuning voltage will increase, and the oscillator frequency will sweep across a frequency range limited by the tuning-voltage range allowed by the unijunction stage. As the oscillator frequency changes, it will eventually reach the equilibrium point at which the tuning-voltage value will cause the reference and signal to be phase-locked. When this point is reached, the sum phasor will again be the sum of the three 1-MHZ phasors and will cause a DC tuning voltage that phase-locks the oscillator.

8-232. If the feedback loop is opened so that the DC tuning-voltage output of MC frequency stabilizer 2A10 no longer controls the oscillator frequency, the oscillator frequency will continue to drift with respect to the reference, and the unijunction stage will recycle continuously. The movement of the signal phasors in this recycle condition will be up and down between the  $V_{MAX}$  and  $V_{MIN}$  positions. If the loop is closed, the signal phasors will stop when they reach the locked position because this is the equilibrium point of the feedback circuit. Note that when the oscillator is locked, the signal phasors should be slightly less than 90 degrees out of phase with the reference. This will cause the sum phasor to be slightly greater than the reference phasor. The position of the signal phasor in the locked position may be varied by adjusting the variable inductor in the oscillator tuned circuit. Doing this will cause the value of capacitance needed to lock the oscillator to change and, therefore, will require the DC tuning voltage to change. When this inductance is changed, the signal phasors will reposition to produce the required tuning voltage. The oscillator will remain locked as long as the signal phasors are anywhere in the range between the  $V_{MAX}$  and  $V_{MIN}$  positions. The lengths of the reference phasor may be adjusted by disconnecting the oscillator input to MC frequency stabilizer 2A10. This will eliminate the signal phasors, leaving the sum phasor equal to the reference phasor. The amplitude of the 500-KHZ reference spectrum pulse is then adjusted to give a reference phasor length that will produce a tuning voltage of approximately 6.5 volts DC.

8-233. The 500-KHZ reference pulse is produced as follows: The 500-KHZ reference sine-wave input from RF oscillator 2A2 is shaped by a squaring amplifier into a rectangular pulse. This pulse is applied to a pulse generator that sharpens the pulse leading edge. The output of the pulse generator is further differentiated by an RL network to produce the 500-KHZ pulse that is applied to the mixer input.

#### 8-234. TEST PROCEDURES.

#### 8-235. TEST SETUP.

8-236. Before interconnecting equipment, ensure that all primary power switches are placed in OFF position.

### WARNING

Before connecting the primary power cable to the bench, make sure that a ground strap is connected between the ground lug on the bench and the nearest ground point of the primary power source.

Interconnect test equipment as shown in figure 2-1. Deviations from the test equipment hookup diagram are covered in the test procedures. Test equipment required is listed in figure 3-1.

#### NOTE

Equivalent test equipment may be used.

#### 8-237. INITIAL CONTROL SETTINGS.

8-238. Refer to figure 6-8. Deviations from the initial control settings are covered in the test procedures.

#### 8-239. MODULE TEST PROCEDURE.

8-240. Perform the test procedures of figure 8-51 in the order given.

#### 8-241. TROUBLE ANALYSIS.

8-242. Trouble analysis information is incorporated in the PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY column of figure 8-51.

#### 8-243. DISASSEMBLY.

8-244. Disassembly of MC frequency stabilizer 2A10 is self-evident.

#### 8-245. INSPECTION, CLEANING, AND REPAIR.

8-246. Inspection, cleaning, and repair information is contained in section X.

#### 8-247. ASSEMBLY.

8-248. Assembly of MC frequency stabilizer 2A10 is self-evident.

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
1		Initial test requirements	<p>Refer to figure 8-52 for location of all test points on MC frequency stabilizer 2A10.</p> <p>Remove MC frequency stabilizer 2A10 from radio receiver-transmitter chassis, and perform visual inspection.</p> <p>Remove dust cover from module to perform this test procedure.</p> <p>Connect MC frequency stabilizer 2A10 through module extender to radio receiver-transmitter chassis.</p> <p>NOTE</p> <p>Unless otherwise specified, all steps are performed with radio set control mode selector set to AM, no signal in, and radio receiver-transmitter unkeyed.</p> <p>Apply 115-volt, 400-HZ, 3-phase primary power to radio set test harness input power cable W20.</p> <p>Apply 115-volt, 60-HZ, single-phase primary power to HVU blower power cable.</p> <p>Position radio set test harness POWER switch to ON.</p> <p>Position radio set control mode selector to AM.</p> <p>NOTE</p> <p>Allow 15 minutes for equipment to warm up.</p>	<p>Radio set test harness POWER lamp should light, and radio receiver-transmitter blower should operate.</p> <p><b>CAUTION</b></p> <p>Position POWER switch to OFF immediately if blower does not operate.</p>	<p>Repair or replace faulty POWER lamp and/or blower.</p> <p>NOTE</p> <p>Refer to Radio Set Test Bench AN/ARM-86 (TO 33D7-4-14-1) for repair procedures of faulty equipment contained in AN/ARM-86.</p>
2	2A10J2 (H2)	Transistor supply voltage check	<p>Connect HP-410B VTVM DC probe to testpoint (H2).</p> <p>Check voltage at test point (H2).</p>	+17 to +19 V.	Check power supply 2A7.

Figure 8-51. Module Checks and Adjustments, MC Frequency Stabilizer 2A10 (Sheet 1 of 5)

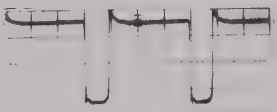
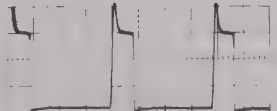
STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
3	2A10J1 (H1)	HF oscillator DC tuning voltage output check	Connect HP-410B VTVM DC probe to test point (H1).  Check voltage at test point (H1).	6.3 to 7.3 V.	Check 2A1A2Q1 through 2A1A2Q4 and associated circuits.
4	2A10J3 (H3)	17.5-MHZ oscillator DC tuning voltage output check	Connect HP-410B VTVM DC probe to test point (H3).  Set radio set control operating frequency to any frequency from 2.000 to 6.999 MHZ.  Check voltage at test point (H3).	6.3 to 7.3 V.	Check 2A1A1Q1 through 2A1A1Q4 and associated circuits.
5	2A10J4 (H4)	HF oscillator RF input check	Connect type 340 voltmeter to test point (H4).  Check voltage at test point (H4).	100 MV RMS minimum.	Check 2A12V11 and associated circuit.
6	2A10J5 (H5)	17.5-MHZ oscillator RF input check	Connect type 340 voltmeter to test point (H5).  Check voltage at test point (H5).	100 MV RMS minimum.	Check 2A12V10 and associated circuit.
7	2A10A3T P1 (H6) 0.	Squaring amplifier output check	Set oscilloscope for 0.5 V/CM, 1.0 US/CM.  Check oscilloscope vertical input to test point (H6).  Check waveform at test point (H6).	  1.8 V peak to peak.	Check 2A10A3Q1 and associated circuit.
8	2A10A3T P2 (H7) 0.	Pulse generator output check	Set oscilloscope for 5 V/CM, 0.5 US/CM.  Connect oscilloscope vertical input to test point (H7).  Check waveform at test point (H7).	  20 to 28 V peak to peak.	Check 2A10A3Q2 and associated circuit.

Figure 8-51. Module Checks and Adjustments, MC Frequency Stabilizer 2A10 (Sheet 2 of 5)

Figure 8-51. Module Checks and Adjustments, MC Frequency Stabilizer 2A10 (Sheet 3 of 5)

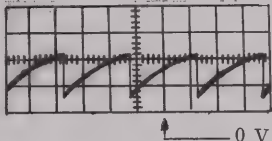
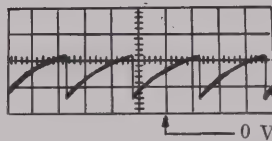
STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
13		Recycle check	<p>The two coaxial jumpers remain disconnected.</p> <p>Connect signal generator through 6-DB attenuator to module input at A1 on module extender.</p> <p>Connect type 340 voltmeter to test point <b>(H5)</b>.</p> <p>Set signal generator output level for 80 MV at 17.503 MHZ (as indicated on type 340 voltmeter).</p> <p>Connect oscilloscope vertical input to test point <b>(H3)</b>.</p> <p>Set oscilloscope for 5 V/CM, DC, 5 MS/CM.</p> <p>Check waveform at test point <b>(H3)</b>.</p> <p>Connect signal generator through 6-DB attenuator to module input at A2 on module extender.</p> <p>Connect type 340 voltmeter to test point <b>(H4)</b>.</p> <p>Tune signal generator output level for 80 MV at 8.003 MHZ (as indicated on type 340 voltmeter).</p> <p>Connect oscilloscope vertical input to test point <b>(H1)</b>.</p> <p>Set oscilloscope for 5 V/CM, DC, 5 MS/CM.</p> <p>Check waveform at test point <b>(H1)</b>.</p>	 <p>Peak value must be +9 to +12 V. Minimum value must be 5 to 15 MS.</p>  <p>Peak value must be +9 to +12 V. Minimum value must be 0 to +4 V. Period must be 5 to 15 MS.</p>	<p>Check 2A10A3Q3 and associated circuit. Repair or replace faulty components as necessary.</p> <p>Check 2A10A3Q4 and associated circuit.</p>

Figure 8-51. Module Checks and Adjustments, MC Frequency Stabilizer 2A10 (Sheet 4 of 5)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
14		Disconnect	<p>Turn off power.</p> <p>Disconnect all test equipment. Remove MC frequency stabilizer 2A10 from module extender.</p> <p>Remove module extender from radio receiver-transmitter chassis.</p> <p>Reconnect coaxial jumpers to module extender.</p> <p>Replace dust cover on module, and install module in radio receiver-transmitter chassis.</p>		

Figure 8-51. Module Checks and Adjustments, MC Frequency Stabilizer 2A10 (Sheet 5 of 5)

8-249. MODIFICATION HISTORY.

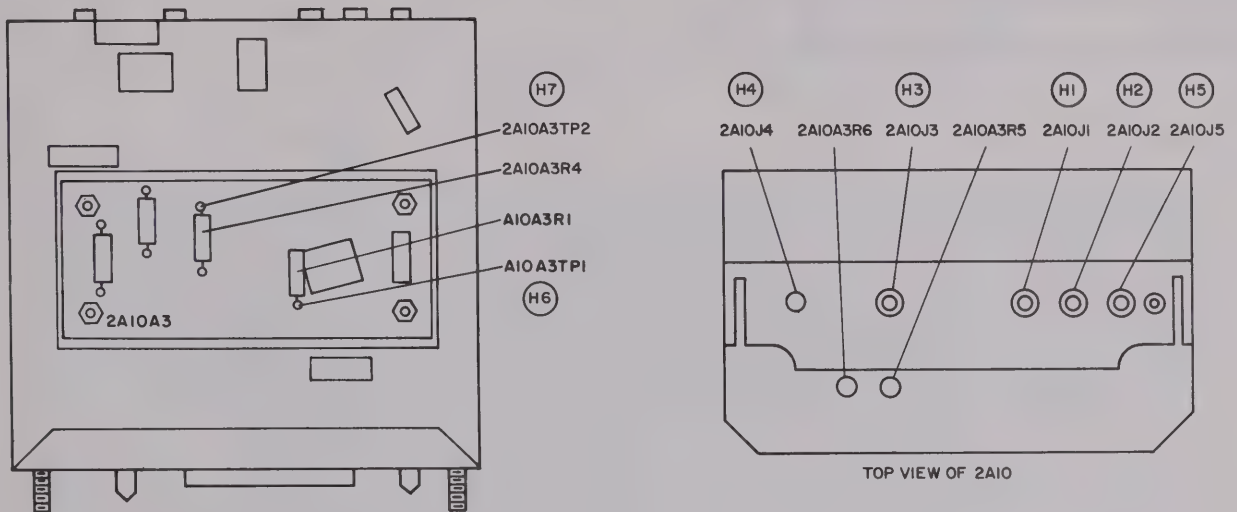
8-250. GENERAL. The following paragraph contains the modification history for MC frequency stabilizer 2A10. The modification history is arranged by MCN or configuration identifier (CI) effectivity.

8-251. MC FREQUENCY STABILIZER 2A10. The modification history is as follows:

NOTE

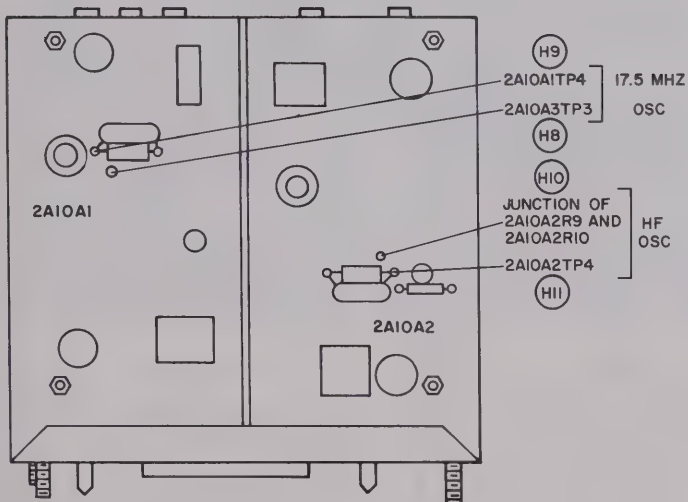
Reference designations are abbreviated. Prefix designations with 2A10.

- a. At MCN 107, changed coils A1L3 and A2L3 from 2.0 to 2.2 millihenrys.
- b. At MCN 107, changed capacitors A1C9 and A2C9 from 0.3 to 1.0 microfarad.
- c. At CI 71136:
  1. Changed A1C2, A1C3, A1C5, A1C13, A2C2, A2C3, A2C5, and A2C13 from 0.02 to 0.022 microfarad.
  2. Changed A1C4 and A2C4 from 0.3 to 0.33 microfarad.
- d. At CI 71145:
  1. Changed A3C3 from 0.02 to 0.022 microfarad.
  2. Changed A3C7 from 0.3 to 0.33 microfarad.
- e. At REV LTR AE, changed A1Q1, A1Q4, A2Q1, and A2Q4 from 2N1285 to 2N3323.



NOTE:

METAL COVER MUST BE REMOVED FROM 2A10A3 TO PERFORM TESTS ON CIRCUIT BOARD.



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Figure 8-52. MC Frequency Stabilizer 2A10, Test-Point and Component Location

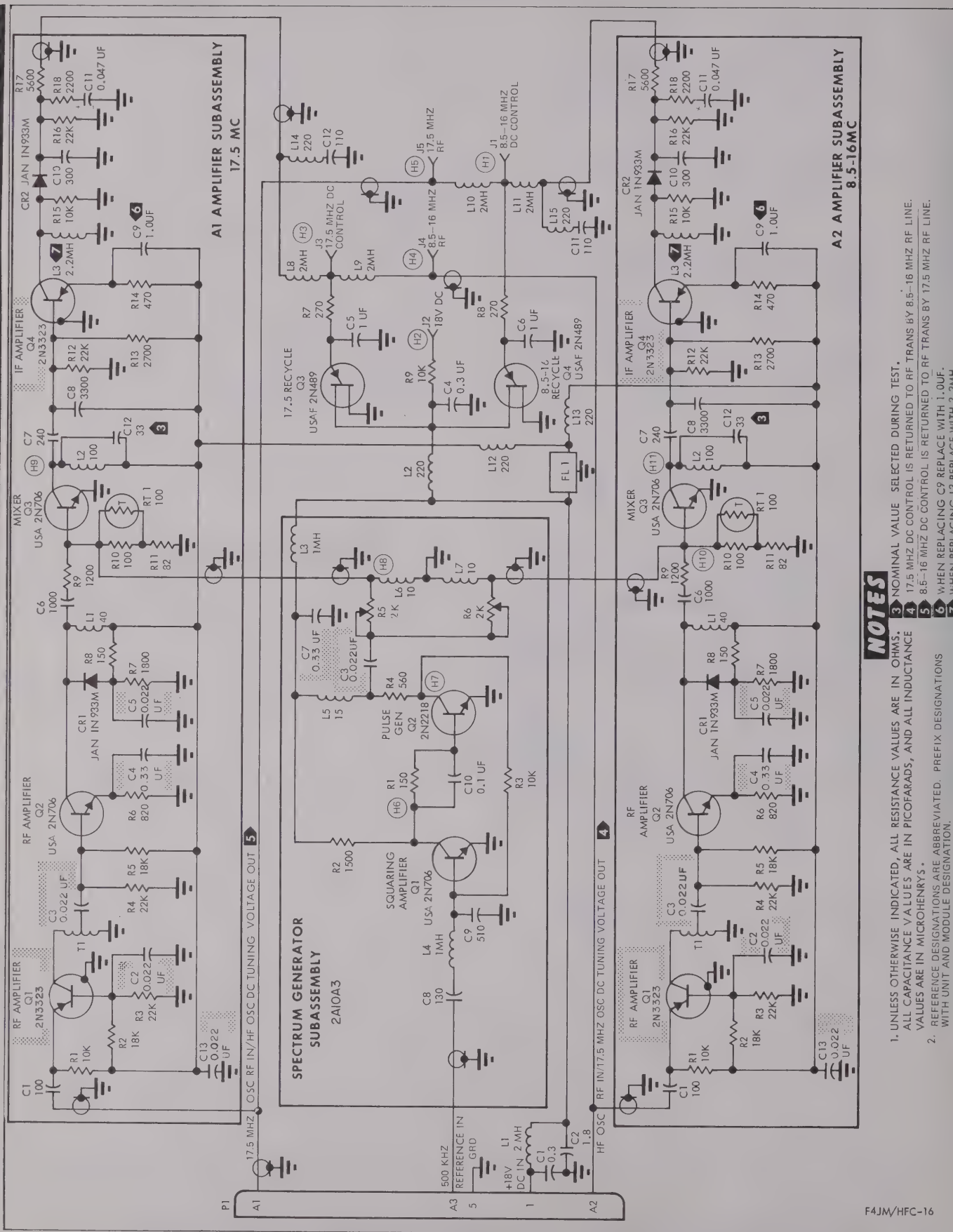


Figure 8-53. MC Frequency Stabilizer 2A10, Schematic Diagram

**2A11**  
**POWER AMPLIFIER**  
**THEORY AND MAINTENANCE**



POWER AMPLIFIER 2A11

	Paragraph Number
CIRCUIT ANALYSIS	8-253
TEST PROCEDURES	8-259
TEST SETUP	8-260
INITIAL CONTROL SETTINGS	8-262
MODULE TEST PROCEDURE	8-264
TROUBLE ANALYSIS	8-266
DISASSEMBLY	8-268
INSPECTION, CLEANING, AND REPAIR	8-270
ASSEMBLY	8-272
MODIFICATION HISTORY	8-274

Figure 8-54. Power Amplifier 2A11, Maintenance Marker

### 8-252. POWER AMPLIFIER 2A11.

#### 8-253. CIRCUIT ANALYSIS.

8-254. GENERAL. Power amplifier 2A11 amplifies the low-level RF output of RF translator 2A12. The power output is 400 watts PEP nominal in the single-sideband modes and 125 watts in the AM mode. The plate circuit is under the control of TGC (transmit gain control) circuits and ADC (automatic drive control) circuits. Voice peaks that cause grid current flow develop a control voltage for an ALC (automatic load control) circuit that reduces drive.

8-255. BLOCK DIAGRAM ANALYSIS. (Refer to figure 8-55.) The 2- to 30-MHZ output of RF translator

2A12 is applied to parallel linear power amplifiers 2A11V1 and 2A11V2. The output of the power amplifier is applied to a tuned output network. This output network is a pisection that matches the 100-ohm amplifier plate impedance to the 52-ohm antenna impedance.

8-256. In the output network, the signal is tapped off and applied to a phase discriminator network. The phase discriminator compares the phase of the input and output signals of power amplifier 2A11. The phase discriminator produces a DC error signal proportional in polarity and magnitude to the direction and magnitude of the phase error. The DC error signal is applied to electronic control amplifier 2A6.

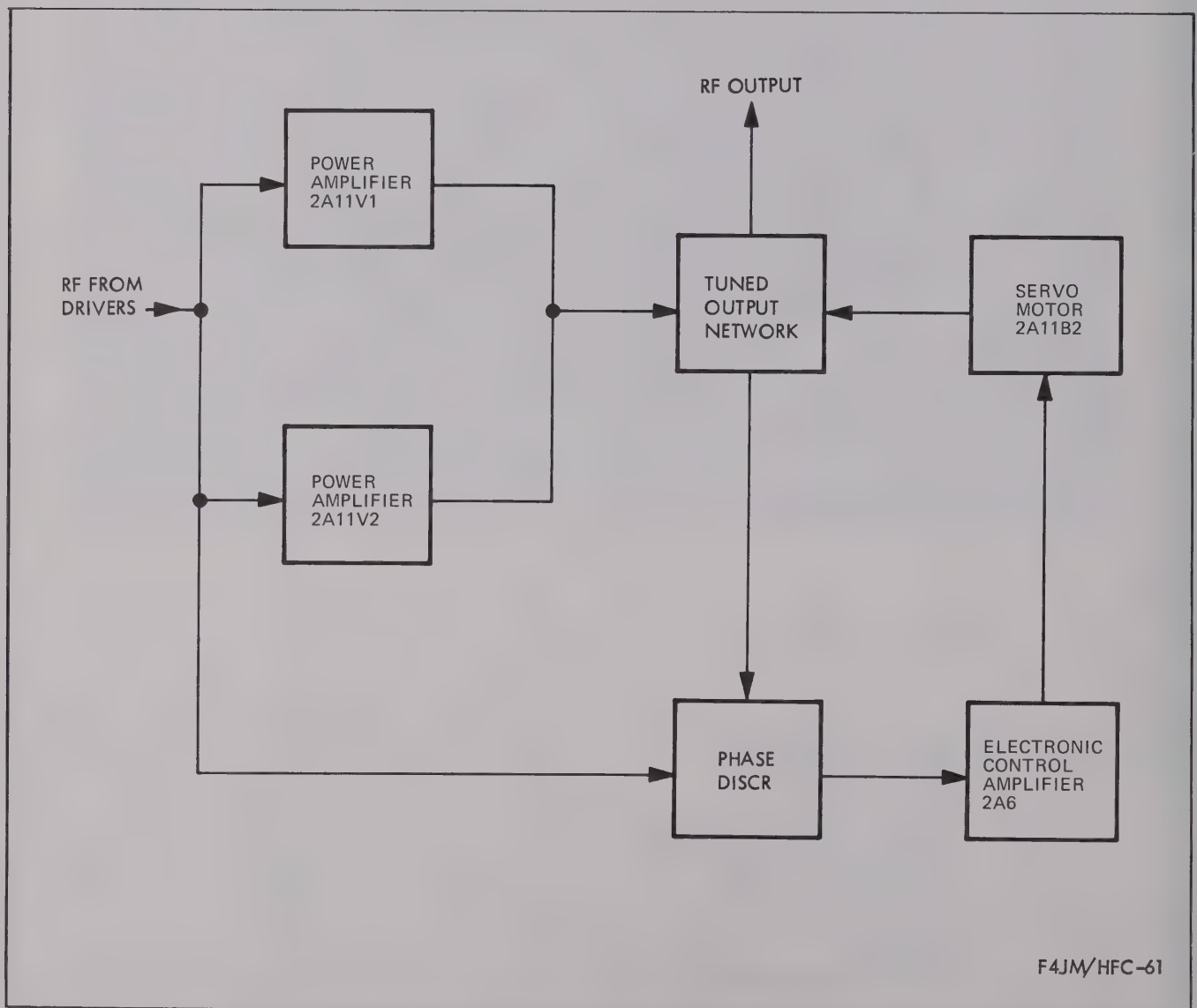


Figure 8-55. Power Amplifier 2A11, Block Diagram

Electronic control amplifier 2A6 produces a 400-HZ error signal which is applied to servo motor 2A11B2. The servo motor drives variable inductor 2A11L4, which tunes the output circuit until the input and output signals are exactly 180 degrees out of phase.

8-257. DETAILED CIRCUIT ANALYSIS. (Refer to figures 8-56 and 8-59). The shunt capacitances and part of the series inductance of the output network is switched by motor 2A11B1 in eight discrete steps or bands. Motor 2A11B1 is controlled by band switch 2A12S12 in RF translator 2A12. In some of the eight bands, variable inductor 2A11L4 is in series with the other inductors, while in other bands it is in a series-parallel arrangement. In both circuits, the values of inductances are selected so that the tuning range of the output circuit never exceeds 1.7 as the variable inductor is varied from one of its extremes to the other. Band 1, for example, has a ratio of 3 MHZ to 2 MHZ or 1.5 to 1. Inductor 2A11L8 is a compensating inductor that is tapped so that the parallel combination of 2A11L8 and  $C_{OUT}$  (line capacitance) approaches resonance at the high end of the band in use. The high impedance of this parallel resonant circuit keeps the output impedance and the amplifier plate load nearly constant over the entire tuning range of the band in use.

8-258. The 52-ohm output of the amplifier is coupled to the antenna coupler. A signal from the antenna coupler during the tuning cycle energizes relay 2A11K2 and places two parallel 50-ohm resistors in series with the power amplifier output during the tuning cycle. This reduces the power in the output circuit so that it will not be damaged when the antenna is being tuned. The resistors also provide isolation between power amplifier 2A11 and the antenna coupler during the tuning cycle.

8-259. TEST PROCEDURES.

8-260. TEST SETUP.

8-261. Before interconnecting equipment, ensure that all primary power switches are placed in OFF position.

### WARNING

Before connecting the primary power cable to the bench, make sure that a ground strap is connected between the ground lug on the bench and the nearest ground point of the primary power source.

Interconnect test equipment as shown in figure 2-1. Deviations from the test equipment hookup diagram are covered in the test procedures. Test equipment required is listed in figure 3-1.

### NOTE

Equivalent test equipment may be used.

8-262. INITIAL CONTROL SETTINGS.

8-263. Refer to figure 6-8. Deviations from the initial control settings are covered in the test procedures.

8-264. MODULE TEST PROCEDURE.

8-265. Perform the test procedures of figure 8-57 in the order given.

8-266. TROUBLE ANALYSIS.

8-267. Trouble analysis information is incorporated in the PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY column of figure 8-57.

8-268. DISASSEMBLY.

8-269. Disassembly of power amplifier 2A11 may be accomplished at depot maintenance facilities only. Refer to section X for disassembly procedures.

8-270. INSPECTION, CLEANING, AND REPAIR.

8-271. Inspection, cleaning, and repair information is contained in section X.

8-272. ASSEMBLY.

8-273. Assembly procedures for power amplifier 2A11 are contained in section X.

8-274. MODIFICATION HISTORY.

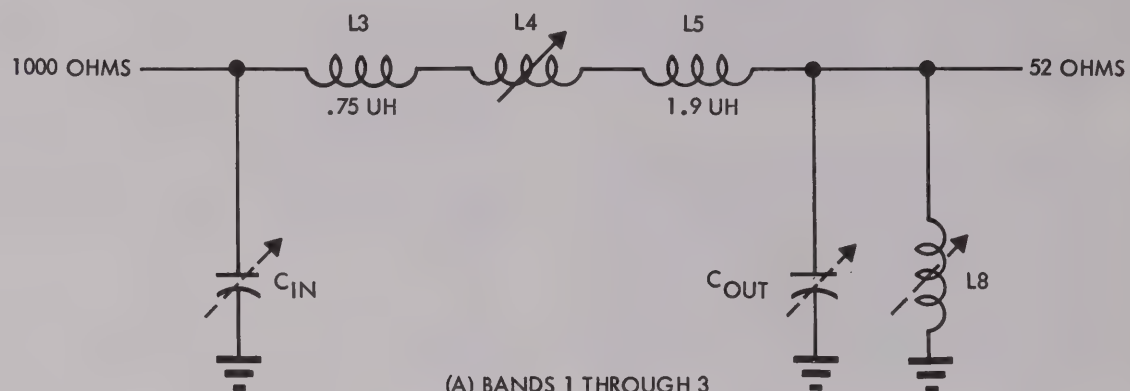
8-275. GENERAL. The following paragraph contains the modification history for power amplifier 2A11.

8-276. POWER AMPLIFIER 2A11. The modification history is as follows:

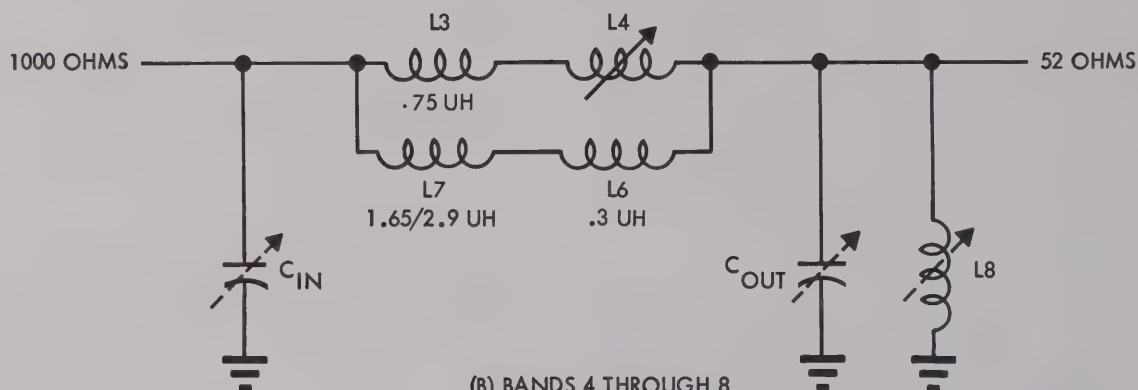
### NOTE

Reference designations are abbreviated. Prefix designations with 2A11.

- Changed diode CR3 from 1N198 to JAN 1N933.
- Changed capacitor C41 from 10 to 33 microfarads.
- Changed capacitor C6 from 40 to 30 picofarads.
- At REV LTR E, changed CR1 from 1N547 to 1N4247.



(A) BANDS 1 THROUGH 3



(B) BANDS 4 THROUGH 8

BAND	RANGE (MHZ)	FREQUENCY RATIO
1	2-3	1.5:1
2	3-4	1.3:1
3	4-6	1.3:1
4	6-8	1.5:1
5	8-11	1.4:1
6	11-16	1.5:1
7	16-22	1.4:1
8	22-30	1.4:1

**NOTE**

BROKEN ARROW INDICATES THAT VALUE IS VARIED IN 8 STEPS.

F4JM/HFC-60

Figure 8-56. Power Amplifier 2A11, Simplified Schematic Diagram of Output Network

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
1		Initial test requirements	<p>Refer to figure 8-58 for location of all test points on power amplifier 2A11.</p> <p>Remove power amplifier 2A11 from radio receiver-transmitter chassis, and perform visual inspection.</p> <p>Remove dust cover from power amplifier 2A11 to perform this step.</p> <p>Connect power amplifier to radio receiver-transmitter chassis.</p> <p>NOTE</p> <p>Unless otherwise specified, all steps are performed with radio set control mode selector set to AM, no signal in, and radio receiver-transmitter unkeyed.</p> <p>Apply 115-volt, 400-Hz, 3-phase primary power to radio set test harness input power cable W20.</p> <p>Apply 115-volt, 60-HZ, single-phase primary power to HVU blower power cable.</p> <p>Position radio set test harness POWER switch to ON.</p> <p>Position radio set control mode selector to USB, any frequency.</p> <p>NOTE</p> <p>Allow 15 minutes for equipment to warm up.</p> <p><b>WARNING</b></p> <p>Voltages dangerous to life exist in power amplifier 2A11.</p>	<p>Radio set test harness POWER lamp should light, and radio receiver-transmitter blower should operate.</p> <p><b>CAUTION</b></p> <p>Position POWER switch to OFF immediately if blower does not operate.</p>	<p>Repair or replace faulty POWER lamp and/or blower.</p> <p>NOTE</p> <p>Refer to Radio Set Test Bench AN/ARM-86 (TO 33D7-4-14-1) for repair procedures of faulty equipment contained in AN/ARM-86.</p>

Figure 8-57. Power Amplifier 2A11, Module Checks and Adjustments (Sheet 1 of 4)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
2		Static plate current adjustment	Position R/T TEST SWITCH on radio set test harness to PA MA position.  Position KEY switch on radio set test harness to ON, note reading on R/T TEST METER and unkey.	R/T TEST METER should indicate 2.5 to 3.0 meter increments.	Adjust 2A11R2 to provide required results.
3		TGC adjustment	<div style="border: 1px solid black; padding: 2px; text-align: center; font-weight: bold;">CAUTION</div> Do not key radio receiver-transmitter with power amplifier 2A11 cover off or with loose cover screws.  Connect HP-410B VTVM as in figure 2-1.  Set radio set control mode selector to AM, frequency selector knobs to 2.100 MHZ.  Key radio receiver-transmitter.  Check voltage on HP-410B VTVM.  Unkey radio receiver-transmitter.  Disconnect HP-410B.	80 volts.	Adjust TGC ADJ control 2A11R5 to provide required results.
4	2A11J5 I5	ADC adjustment	Set radio set control mode selector to AM, frequency selector knobs to 2.900 MHZ.  Remove plug at upper left of power amplifier 2A11 cover.  Connect HP-410B VTVM DC probe to test point I5.  <div style="border: 1px solid black; padding: 2px; text-align: center; font-weight: bold;">CAUTION</div> Make adjustment quickly to avoid damage to module due to lack of cooling air. Replace plug as soon as adjustment is made.  Key radio receiver-transmitter.  Check voltage at test point I5.  Unkey radio receiver-transmitter.  Disconnect HP-410B VTVM.	-4.75 volts DC.	Adjust 2A11R20 to provide required results.

Figure 8-57. Power Amplifier 2A11, Module Checks and Adjustments (Sheet 2 of 4)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
5	2A11J1 (I1)	Power amplifier grid voltage check	<p>Connect HP-410B VTVM DC probe to test point (I1).</p> <p>Set radio set control mode selector to AM, any frequency.</p> <p>Key radio receiver-transmitter.</p> <p>Check voltage at test point (I1).</p> <p>Unkey radio receiver-transmitter.</p>	-55 to -85 volts DC. Record this reading for reference.	Check bias circuit. Replace faulty components if necessary.
6	2A11J2 (I2)	TGC reference voltage check	<p>Connect HP-410B VTVM to test point (I2).</p> <p>Set radio set control mode selector to AM.</p> <p>Key radio receiver-transmitter.</p> <p>Check voltage at test point (I2).</p> <p>Unkey radio receiver-transmitter.</p>	-5 to -7 V.	Check 2A11R4, 2A11R5, and/or 2A11CR6.
7	2A11J3 (I3)	Power amplifier screen voltage check	<p>Connect HP-410B VTVM DC probe to test point (I3).</p> <p>Set radio set control mode selector to AM.</p> <p>Key radio receiver-transmitter.</p> <p>Check voltage at test point (I3).</p> <p>Unkey radio receiver-transmitter.</p>	+360 to +440 VDC.	PA B+ abnormal; Check 2A11R29 through 2A11R34, 2A11C38, 2A11C45, 2A11C51, and 2A11C52.
8  (Cont)	2A11J1 (I1)	Bias supply voltage check	<p>Connect VOM between test point (I1) (+) and test point (I4) (-).</p> <p>Set radio set control mode selector to AM.</p> <p>Key radio receiver-transmitter.</p>		

Figure 8-57. Power Amplifier 2A11, Module Checks and Adjustments (Sheet 3 of 4)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
8 (Cont)			Check voltage between test point (I1) and test point (I4).	Approximately 1.5 VDC less than voltage at test point (I1) (see reference in step 5).	Check bias circuit.
9		Disconnect	Unkey radio receiver-transmitter. Turn off power. Disconnect all test equipment.		

Figure 8-57. Power Amplifier 2A11, Module Checks and Adjustments (Sheet 4 of 4)

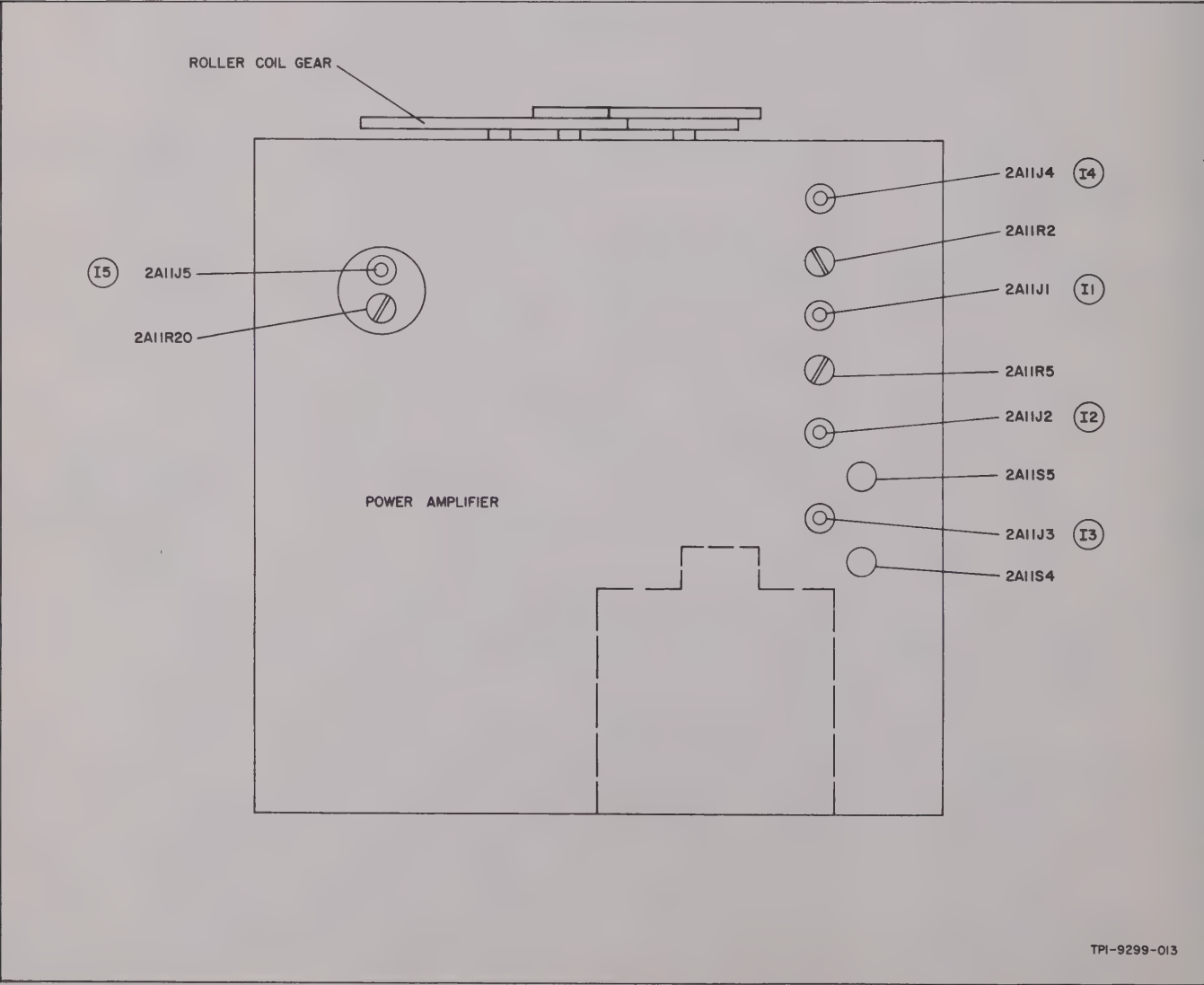


Figure 8-58. Power Amplifier 2A11, Test-Point and Component Location

LE CAUSE  
NORMAL  
LT AND  
MEDY



STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
8 (Cont)			Check voltage between test point <b>I1</b> and test point <b>I4</b> .	Approximately 1.5 VDC less than voltage at test point <b>I1</b> (see reference in step 5).	Check bias circuit.
9		Disconnect	Unkey radio receiver-transmitter. Turn off power. Disconnect all test equipment.		

Figure 8-57. Power Amplifier 2A11, Module Checks and Adjustments (Sheet 4 of 4)

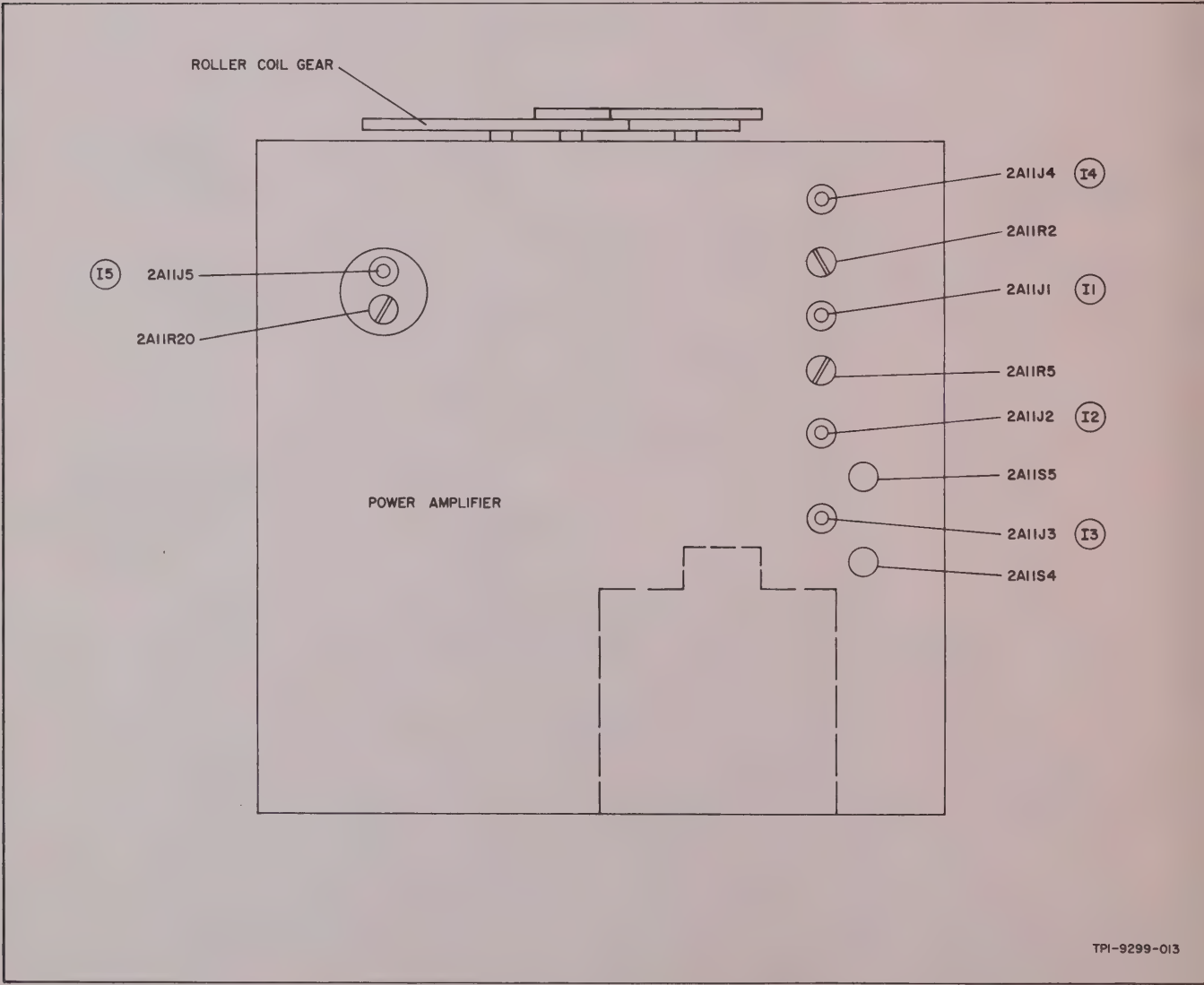
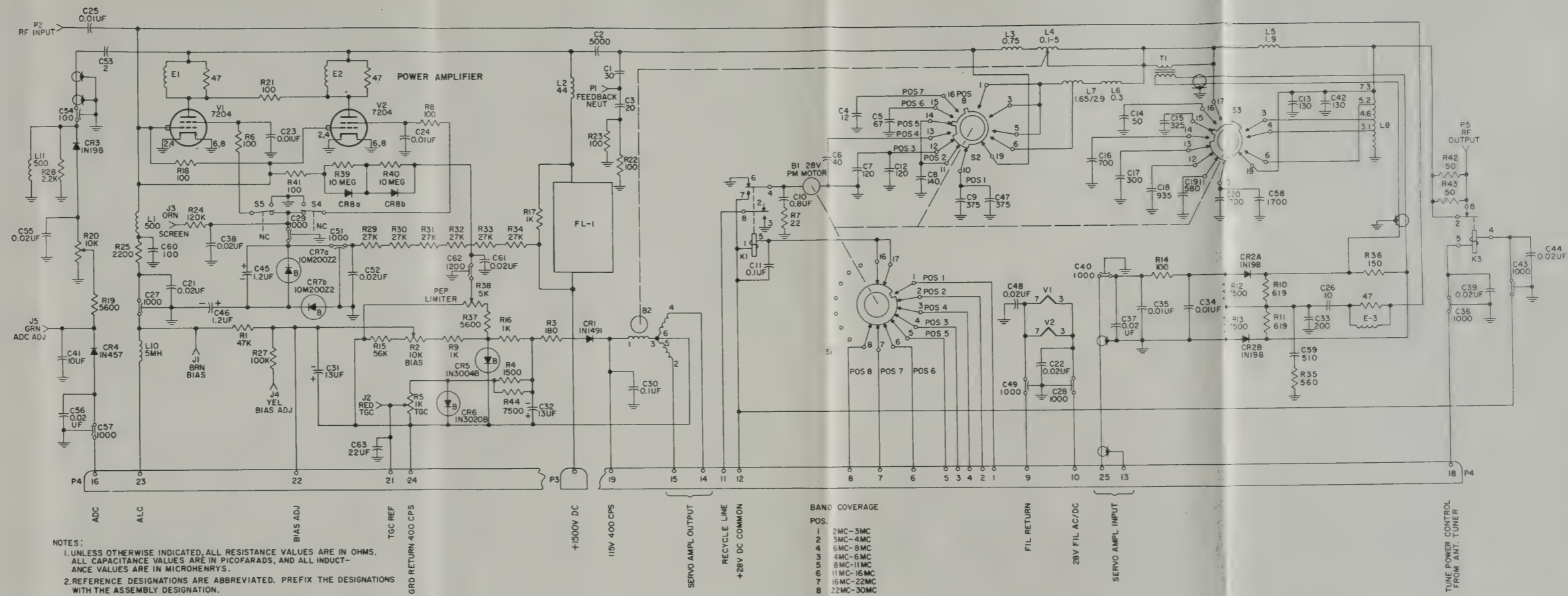


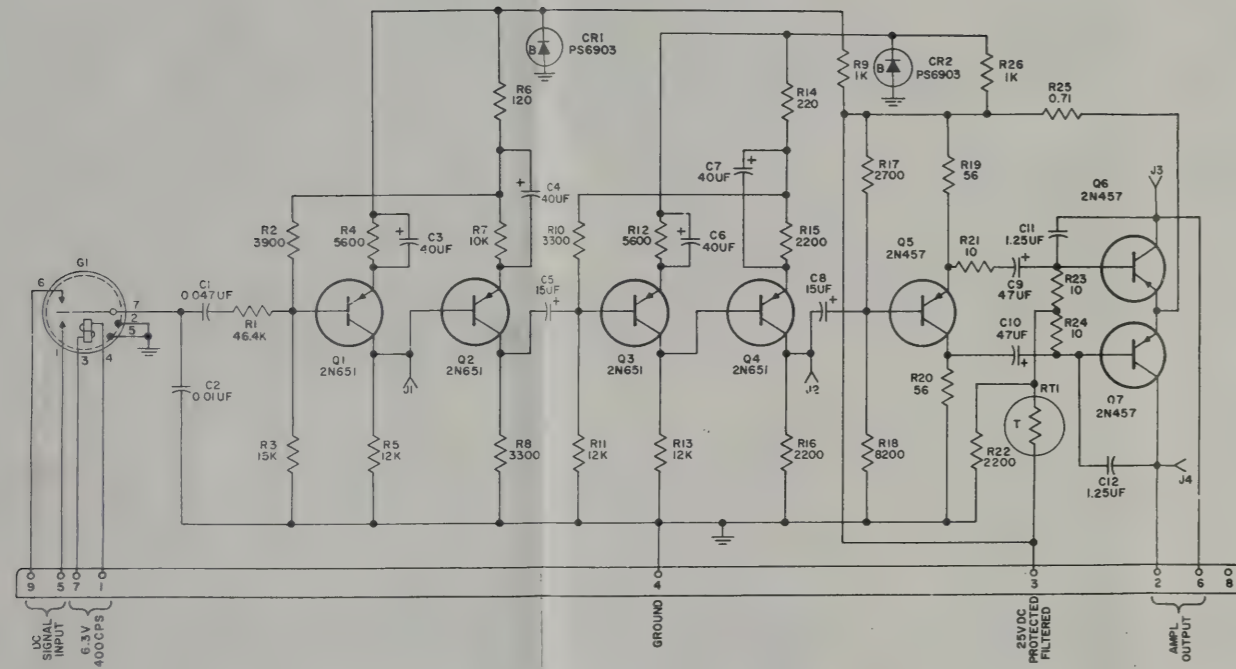
Figure 8-58. Power Amplifier 2A11, Test-Point and Component Location



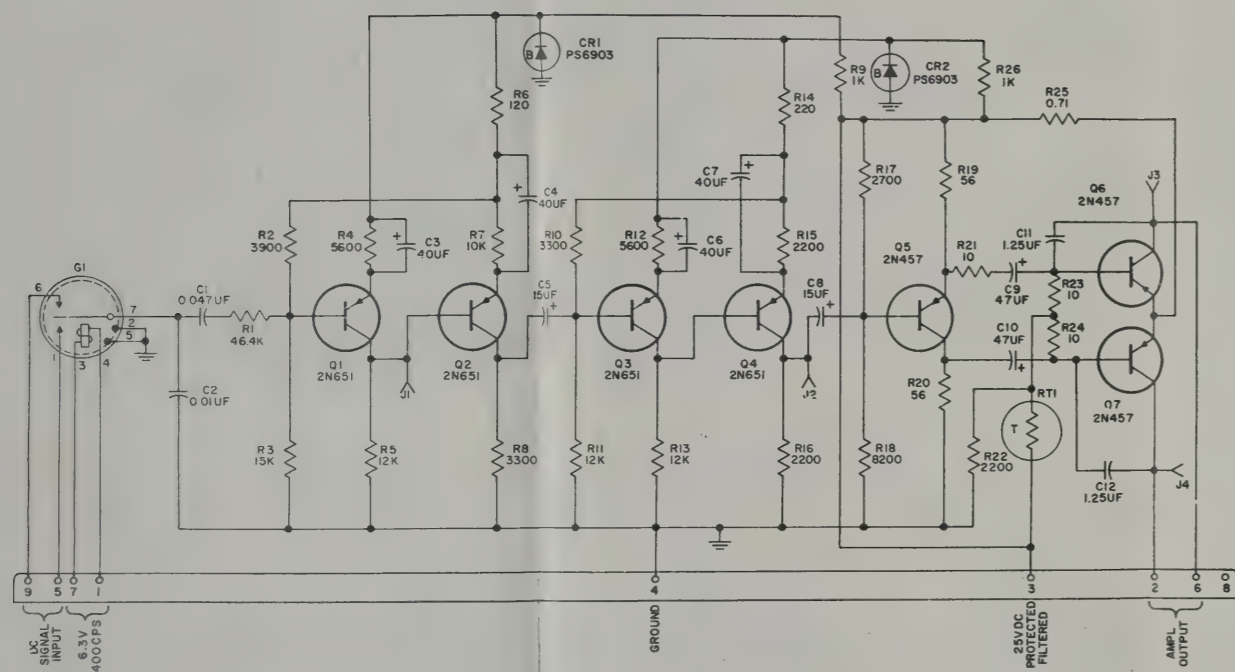
Power Amplifier Module, Schematic Diagram  
Figure 1109



Figure 8-66. RF Translator 2A12, Module Checks and Adjustments (Sheet 11 of 26)



Electronic Control Amplifier Module,  
Schematic Diagram  
Figure 1110



Electronic Control Amplifier Module,  
Schematic Diagram  
Figure 1110

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
13 (Cont)	2A12J2 (J2)		<p>Set radio set control frequency selector knobs to 6.000 MHZ.</p> <p>Key radio receiver-transmitter.</p> <p>Adjust signal generator for 0.5 V at test point (J2) at 6.000 MHZ unmodulated.</p> <p>Vary radio set control from 6.000 to 6.900 MHZ in 100-KHZ steps.</p> <p>Unkey.</p> <p>NOTE</p> <p>If the maximum-to-minimum voltage at test point (J2) is more than 2:1 across the frequency range, complete this test procedure. If the variation is less than 2:1, both the variable and bandpass IF circuits are aligned properly.</p> <p>Set radio set control frequency selector knobs to 8.000 MHZ.</p> <p>Key radio receiver-transmitter.</p> <p>Adjust signal generator to provide 0.5 V at test point (J2) at 500 KHZ.</p> <p>Vary radio set control from 8.000 to 8.999 MHZ in 100-KHZ steps.</p> <p>Unkey radio receiver-transmitter.</p> <p>If the maximum-to-minimum voltage at test point (J2) is more than 2:1 across the frequency range, perform the variable IF alignment procedure.</p> <p>If the variation is within the specified limits, perform the bandpass IF alignment procedure.</p>		
13A (Cont)	2A12J3 (J3)	Variable IF alignment	Ground test point (J3) to radio receiver-transmitter chassis.		

Figure 8-66. RF Translator 2A12, Module Checks and Adjustments (Sheet 12 of 26)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
13A (Cont)	2A12J2 (J2)		<p>Connect HP-410B VTVM AC probe to test point (J2).</p> <p>Replace HF oscillator tube A12V11 with a 6AH6WA tube with pin 1 cut off.</p> <p>Set radio set control frequency selector knobs to 8.999 MHZ, mode selector to AM.</p> <p>Key radio receiver-transmitter.</p> <p>Adjust signal generator to provide approximately 0.5 V at test point (J2).</p> <p>Keep voltage at test point constant by varying signal generator output level during the following procedure.</p> <p>Adjust 2A12L2, 2A12L3, 2A12L4, and 2A12L130 to peak voltage at test point (J2). 2A12L130 may be adjusted to give two peaks. Adjust for the peak that provides the highest voltage at test point (J2).</p> <p>Unkey.</p> <p>Set radio set control frequency selector knobs to 8.000 MHZ.</p> <p>Key radio receiver-transmitter.</p> <p>Adjust 2A12C7, 2A12C10, and 2A12C13 to peak voltage at test point (J2).</p> <p>Repeat peaking procedure until no further improvement can be made.</p> <p>Unkey.</p> <p>Set radio set control mode selector to OFF position.</p> <p>Remove 6AH6WA tube, and replace it with the original tube.</p>		
(Cont)					

Figure 8-66. RF Translator 2A12, Module Checks and Adjustments (Sheet 13 of 26)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
13A (Cont)			<p>NOTE</p> <p>At this point, repeat step 13, variable/bandpass IF alignment check.</p> <p>Set radio set control frequency selector knobs to X.500 MHZ.</p> <p>Check that both slug racks are equal in height above the chassis (within 1/32 inch). If they are not, loosen setscrews in slug rack gear, and position racks properly. Tighten setscrews.</p> <p>Set radio set control frequency selector knobs to X.600 MHZ; reset to X.500 MHZ. Again check to see that slug racks are positioned at the same height. If they are not, reposition them. Set radio set control frequency selector knobs to X.000 MHZ.</p> <p>Turn off power.</p> <p>Remove RF translator 2A12 from module extender.</p> <p>Remove bottom cover plate from 2A12.</p> <p>From bottom of module, inspect slugs and capacitor driven by slug rack.</p> <p>Measure distance from capacitor bottom to capacitor form bottom.</p> <p>Measure distance from slug bottoms to coil bottoms.</p>	Variable IF circuits aligned properly.	Variable IF circuits aligned incorrectly. Continue test procedure.
(Cont)			<p>NOTE</p> <p>If any of the preceding mechanical adjustments are made, repeat peaking procedures performed earlier in this step.</p> <p>Replace bottom cover plate on 2A12.</p>	<p>2A12C139-1/8 IN</p> <p>2A12L6-1/4 IN 2A12L37-1/4 IN 2A12L40-1/4 IN 2A12L59-11/32 IN</p>	Adjust slugs and/or capacitor from top of module. Use NO 8 Bristol wrench supplied in Electronic Equipment Maintenance Kit MK-825/ARM-86.

Figure 8-66. RF Translator 2A12, Module Checks and Adjustments (Sheet 14 of 26)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
13A (Cont)	2A12J3 (J3)		Unground test point (J3).  Replace RF translator 2A12 on module extender.		
13B	2A12J3 (J3)  2A12J2 (J2)   2A12J2 (J2)   2A12J2 (J2)	Bandpass IF alignment	<p>NOTE</p> <p>Before performing this step, perform step 13, variable/bandpass IF alignment check, to determine if the following alignment procedure is required.</p> <p>Ground test point (J3) to radio receiver-transmitter chassis.</p> <p>Connect HP-410B VTVM AC probe to test point (J2).</p> <p>Set radio set control frequency selector knobs, mode selector to 6.500 MHZ, AM.</p> <p>Key radio receiver-transmitter.</p> <p>Adjust signal generator to provide approximately 0.5 VRMS at test point (J2). Keep voltage at test point (J2) constant by varying signal generator output level during the following peaking procedure.</p> <p><b>CAUTION</b></p> <p>In the following step, adjust the two coils only. Do not adjust any other coil in 2A12FL1 at this time.</p> <p>Adjust 2A12L123 then 2A12L128 to peak voltage at test point (J2). These adjustments are through holes in module end plate nearest filter 2A12FL1.</p> <p>Unkey.</p> <p>NOTE</p> <p>At this point, repeat step 13, variable/bandpass IF alignment check.</p>	Bandpass IF circuits aligned properly.	Bandpass IF circuits aligned incorrectly.  Continue test procedure.

Figure 8-66. RF Translator 2A12, Module Checks and Adjustments (Sheet 15 of 26)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
14		Transmit gain check	<p>Connect signal generator, through GENERATOR LOAD supplied in Electronic Equipment Maintenance Kit MK-825/ARM-86 to J34 on module extender.</p> <p>Connect RF TRANSLATOR LOAD, supplied in Electronic Equipment Maintenance Kit MK-825/ARM-86, to 2A12P2 and 2A12P3 so that the blue test point is connected to 2A12P2.</p> <p>Connect HP-410B VTVM AC probe to blue test point on RF TRANSLATOR LOAD.</p> <p>Set signal generator to 500 KHZ unmodulated.</p> <p>Set radio set control mode selector to AM, frequency selector knobs to 2 MHZ.</p> <p style="text-align: center;"><b>CAUTION</b></p> <p>Do not exceed 40 VRMS at RF translator load blue test point or damage to driver plate load may result.</p> <p>Key radio receiver-transmitter.</p> <p>Adjust signal generator output level for 40 VRMS HP-410B VTVM.</p> <p>Unkey radio receiver-transmitter.</p> <p>Set signal generator to provide 20 V on HP-410B VTVM.</p> <p>Set radio set control mode selector to AM, frequency selector knobs to 2.999 MHZ.</p> <p>Key radio receiver-transmitter.</p> <p>Adjust signal generator output level for 40 V on HP-410B VTVM.</p> <p>Repeat above procedure at 1-MHZ increments for entire frequency range (2 to 2.999 MHZ through 29 to 29.999 MHZ).</p> <p>Unkey.</p>	<p>Not more than 4000-UV signal generator output.</p> <p>Signal generator output level should be within 12 DB of output required for 40 V at 2 MHZ.</p> <p>Signal generator output level required to produce 40 VRMS on the HP-410B VTVM should not vary more than 12 DB across any one band.</p>	<p>RF circuits not aligned properly.</p> <p>Perform step 15 of this test procedure.</p>
(Cont)					

Figure 8-66. RF Translator 2A12, Module Checks and Adjustments (Sheet 16 of 26)

[illegible]

Figure 8-66. RF Translator 2A12, Module Checks and Adjustments (Sheet 17 of 26)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
15 (Cont)			<p>Set switch 2A12S15 (FEEDBACK) to maximum CCW position.</p> <div style="border: 1px solid black; padding: 5px; text-align: center; width: fit-content; margin: 10px auto;"><b>CAUTION</b></div> <p>Never operate switch 2A12S15 while radio receiver-transmitter is keyed.</p> <p>Key radio receiver-transmitter, and adjust signal generator to provide approximately 30 volts as measured on HP-410B VTVM.</p> <p>Adjust 2A12L9A, 2A12L23A, and 2A12L43A to peak voltage on HP-410B. Readjust signal generator to maintain approximately 30 volts on HP-410B.</p> <p style="text-align: center;">NOTE</p> <p>Adjust signal generator to keep output voltage on HP-410B at approximately 30 volts during remainder of this test.</p> <p>With radio receiver-transmitter keyed, adjust MIXER PLATE, RF AMP GRID, and RF AMP PLATE coils to peak voltage on HP-410B.</p> <p>Unkey radio receiver-transmitter.</p> <p>Set signal generator and radio set control frequency selector knobs to 2.999 MHZ.</p> <p>Key radio receiver-transmitter, and adjust 2A12L7, 2A12L38, and 2A12L42 to peak voltage on HP-410B.</p> <p>Unkey radio receiver-transmitter.</p> <p>Repeat tuning at 2.000 and 2.999 MHZ until tracked.</p> <p>Set signal generator and radio set control frequency selector knobs to 29.000 MHZ.</p> <p>Key radio receiver-transmitter, and adjust MIXER PLATE, RF AMP GRID, RF AMP PLATE, and DRIVER PLATE coils to peak voltage on HP-410B.</p> <p>Unkey radio receiver-transmitter.</p>		
(Cont)					

Figure 8-66. RF Translator 2A12, Module Checks and Adjustments (Sheet 18 of 26)

Figure 8-66. RF Translator 2A12, Module Checks and Adjustments (Sheet 19 of 26)

2A12J3  
J3

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STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
17 (Cont)			<p>Connect VOM to neutralizing detector output jacks, and set VOM to most sensitive current scale. Reverse VOM leads if meter does not read upscale.</p> <p>Set feedback switch 2A12S15 to off by rotating switch fully counter-clockwise.</p> <div style="border: 1px solid black; padding: 5px; text-align: center; width: fit-content; margin: 10px auto;"><b>CAUTION</b></div> <p>Never operate 2A12S15 while keying radio receiver-transmitter.</p> <p>Set radio set control mode selector to USB, and do not key radio receiver-transmitter.</p> <p>Adjust signal generator for 2.0- to 3.0-V output at 29.000 MHZ unmodulated.</p> <p>Adjust driver grid coil 2A12L56B for maximum indication on VOM.</p> <p>Adjust driver plate neutralization capacitor 2A12C128, located below 2A12C141, for null indication on VOM.</p> <p>This completes driver neutralization.</p> <p>Set radio set control mode selector to OFF position.</p> <p>Disconnect all test equipment.</p> <p>Replace turret cover plate.</p> <p>Unground test point (J3).</p> <p>Remove 2A12 from module extender.</p> <p>Remove module extender from radio receiver-transmitter chassis.</p> <p>Replace 2A12 in radio receiver-transmitter chassis.</p> <p>Set radio set control frequency selector knobs to 29.000 MHZ, mode selector to AM.</p>		
(Cont)	2A12J3 (J3)				

Figure 8-66. RF Translator 2A12, Module Checks and Adjustments (Sheet 21 of 26)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
17 (Cont)	2A1J2 (A2) 2A3J2 (C2)		<p>Override TGC as follows:</p> <p>Connect function test set J2-FREQ DIV jack to test point (A2).</p> <p>Connect function test set J2-IF. TRANS jack to test point (C2).</p> <p>Connect function test set GRND jack to radio receiver-transmitter chassis.</p> <p>Set function test set TGC &amp; CAPTURE RANGE control R3 fully counterclockwise.</p> <p><b>CAUTION</b></p> <p>All audio inputs must be removed. Do not modulate. Do not exceed 125-W AM RF output with TGC overridden.</p> <p>Connect HP-410B VTVM AC probe to T-connector in RF output line.</p> <p>NOTE</p> <p>2A12S15 must be in counterclockwise position.</p> <p>Key radio receiver-transmitter.</p> <p>Slowly advance function test set TGC &amp; CAPTURE RANGE control to obtain approximately 50-V RF output.</p> <p>NOTE</p> <p>Do not exceed 50-V RF output during this procedure by adjusting test set TGC &amp; CAPTURE RANGE control.</p> <p>Adjust driver grid coil 2A12L56B for maximum RF output as indicated on HP-410B VTVM.</p> <p>Adjust 2A12L74B in driver plate circuit to peak RF output.</p> <p>While keying, alternately adjust 2A12C141, and rotate large roller coil gear 2A11G4. Roller coil gear 2A11G4, accessible between power amplifier 2A11 gearplate and radio receiver-transmitter</p>		
(Cont)					

Figure 8-66. RF Translator 2A12, Module Checks and Adjustments (Sheet 22 of 26)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
17 (Cont)			<p>chassis, may be rotated by hand. 2A12C141 is adjusted properly when the drop in RF output voltage is approximately symmetrical as the roller coil gear is rotated either side of the tuned position.</p> <p>Unkey radio receiver-transmitter.</p> <p>This completes power amplifier neutralization.</p> <p>Set feedback switch 2A12S15 to on by rotating switch fully clockwise.</p> <p>With TGC overridden, provide approximately 50-V RF output as in preceding step.</p> <p>Key radio receiver-transmitter.</p> <p>Adjust feedback neutralization capacitor 2A12C127. To do this, alternately adjust 2A12C127 and large roller coil gear on power amplifier 2A11. Roller coil gear is accessible between power amplifier module gearplate and radio receiver-transmitter chassis and can be operated with one finger. When 2A12C127 is adjusted properly, a symmetrical RF output voltage will be obtained as roller coil gear is moved either side of tuned position.</p> <p>NOTE</p> <p>Because electronic control amplifier 2A6 supplies an error signal to power amplifier 2A11 for tuning the roller coil, it will return the roller coil to the tuned position when the roller coil is released. It is not necessary to displace the position of the roller coil gear a large amount.</p> <p>Unkey radio receiver-transmitter.</p> <p>Reset TGC as follows:</p> <p>Key radio receiver-transmitter with radio set control frequency selector knobs set to 2.000 MHZ.</p> <p>Note RF output.</p>		
(Cont)					

Figure 8-66. RF Translator 2A12, Module Checks and Adjustments (Sheet 23 of 26)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
17 (Cont)			<p>Repeat in 1-MHZ increments for the entire HF band.</p> <p>Unkey radio receiver-transmitter.</p> <p>Disconnect function test set connections from radio receiver-transmitter.</p> <p>Set radio set control frequency selector knobs to frequency that gave lowest RF output.</p> <p>Key radio receiver-transmitter.</p> <p>Set 2A11R5 for 75-V RF output.</p> <p>Unkey radio receiver-transmitter.</p> <p>This completes neutralization procedures.</p>	Determine which frequency has lowest RF output.	
18	2A3J2 (C2) 2A1J2 (A2)	Receive/transmit gain balance check	<p>Leave RF translator 2A12 connected to radio receiver-transmitter chassis while performing this procedure. Remove RF translator 2A12 top cover plate.</p> <p>Connect function test set J2-IF. TRANS jack to test point (C2).</p> <p>Connect function test set J2-FREQ DIV jack to test point (A2).</p> <p>Connect function test set GRND jack to radio receiver-transmitter chassis.</p> <p>Set function test set FUNCTION SELECTOR control to TGC OVERRIDE.</p> <p>Set function test set TGC &amp; CAPTURE RANGE control R3 fully counterclockwise.</p> <p>Set radio set control frequency selector knobs to 29.000 MHZ, mode selector to AM.</p> <p>Key radio receiver-transmitter.</p> <p>Adjust function test set TGC &amp; CAPTURE RANGE control R3 clockwise until RF output is approximately 30 VRMS.</p>		

Figure 8-66. RF Translator 2A12, Module Checks and Adjustments (Sheet 24 of 26)



STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
18 (Cont)	2J6 		<p>Adjust RF AMP PLATE coil to peak RF output voltage as read on HP-410B VTVM.</p> <p>Unkey radio receiver-transmitter.</p> <p>Set radio set control RF SENS control fully clockwise. Set radio receiver-transmitter AUDIO control 2R10 fully clockwise.</p> <p>Connect signal generator, through 6-DB attenuator, to test point </p> <p>Set signal generator output to 29.000 MHZ, 30% modulated with 1.0 KHZ.</p> <p>Connect HP-400D AC VTVM to radio set test harness HEADSET jack.</p> <p>Adjust signal generator output level to provide 3.0 VRMS at radio set test harness HEADSET jack.</p> <p>Readjust RF AMP PLATE coil to peak voltage at radio set test harness HEADSET jack. If this adjustment causes voltage at radio set test harness HEADSET jack to exceed 3.8 VRMS, replace 2A12C61 with a value of capacitance that will provide the required results.</p> <p>NOTE</p> <p>2A12C61, located in driver compartment, is accessible from bottom of module. 2A12C61 is a selected value of capacitance. Select value of 2A12C61 from complement given in illustrated parts breakdown (TO 12R2-2ARC105-14).</p> <p>If 2A12C61 is replaced, repeat step 17.</p> <p>Set radio set control frequency selector knobs to 7.300 MHZ, mode selector to AM.</p>		
(Cont)					

Figure 8-66. RF Translator 2A12, Module Checks and Adjustments (Sheet 25 of 26)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
18 (Cont)			<p>Set signal generator output to 7.300 MHZ, 1000 UV, 30% modulated with 1 KHZ.</p> <p>Tune signal generator around 7.300 MHZ to peak voltage at radio set test harness HEADSET jack.</p> <p>Adjust AUDIO level control 2R10 for 5.5 VRMS at radio set test harness HEADSET jack.</p> <p>Set radio set control RF SENS control fully counterclockwise.</p>	0.05 VRMS at radio set test harness HEADSET jack.	
19		Disconnect	<p>Turn off power.</p> <p>Disconnect all test equipment.</p>		

Figure 8-66. RF Translator 2A12, Module Checks and Adjustments (Sheet 26 of 26)

#### 8-302. TROUBLE ANALYSIS.

8-303. Trouble analysis information is incorporated in the PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY column of figure 8-66.

#### 8-304. DISASSEMBLY.

8-305. Disassembly of RF translator 2A12 may be accomplished at depot maintenance facilities only. Refer to section X for disassembly procedures.

#### 8-306. INSPECTION, CLEANING, AND REPAIR.

8-307. Inspection, cleaning, and repair information is contained in section X.

#### 8-308. ASSEMBLY.

8-309. Assembly procedures for RF translator 2A12 are contained in section X.

#### 8-310. MODIFICATION HISTORY.

8-311. GENERAL. The following paragraphs contain the modification history for RF translator 2A12. The history is arranged by MCN or configuration identifier (CI) effectivity. In some cases, it was not necessary to record the MCN effectivity.

#### 8-312. RF TRANSLATOR 2A12, MODIFICATION HISTORY. The modification history is as follows:

##### NOTE

Reference designations are abbreviated. Prefix designations with 2A12.

- a. Changed capacitor C126 from 91 to 68 picofarads.
- b. Changed capacitor C141 from 5-25 to 1.5-7 picofarads.
- c. At MCN 591:
  1. Changed resistor R61 from 3300 to 2200 ohms.
  2. Added resistor R94 (120 ohms).
  3. Changed diode CR6 from 11N67A to USN-1N3064.
- d. Deleted capacitor C53 (10 picofarads).
- e. Changed capacitor C6 from 330 to 300 picofarads.
- f. Capacitor C133 was from resistor R95 to tube V7-3; now from resistor R95 to ground.
- g. Capacitor C130 was from resistor R96 to tube V6-3; now from resistor R96 to ground.
- h. Replaced capacitor C234 with circuit from connector P9-15 to resistor R55.
- i. Added capacitor C234 (1000 picofarads) from capacitor C251 to connector P9-15.
- j. At MCN 1319, changed resistor R30 from 5600 to 8200 ohms.
- k. At REV LTR AR:
  1. Added test select capacitor C300.
  2. Added 2.7-microhenry coil L132.



STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
11A (Cont)			<p>If the indications are normal, proceed to step 12.</p> <p>NOTE</p> <p>If the preceding checks indicate that the HF oscillator is unlocked on some of the bands, perform the following adjustment. If the HF oscillator is unlocked on all bands, refer to MC frequency stabilizer 2A10 checks and adjustments (figure 8-51).</p>		
11A Altn	2A10J1 (H1)	Alternate HF oscillator phase-locking check	<p>Couple 51S-1 Receiver to HF oscillator by placing receiver antenna wire near oscillator tube 2A12V11.</p> <p>Set radio set control frequency selector knobs, in turn, to each frequency listed in figure 8-69.</p> <p>Tune 51S-1 Receiver, in turn, to each of the HF oscillator frequencies corresponding to the radio set control frequency.</p> <p>Ground (H1) momentarily at each frequency.</p> <p>If the indications are normal, proceed to step 12.</p> <p>NOTE</p> <p>If the preceding checks indicate that the HF oscillator is unlocked on some of the bands, perform the following adjustment. If the HF oscillator is unlocked on all bands, refer to the MC frequency stabilizer 2A10 checks and adjustments (figure 8-51).</p>	<p>HF oscillator will unlock when test point is grounded; relock to original frequency when test point is ungrounded.</p>	<p>Proceed to step 11B.</p>

Figure 8-66. RF Translator 2A12, Module Checks and Adjustments (Sheet 8A of 26)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
10A Altn	2A10J3 (H3)	Alternate 17.5-MHZ oscillator phase-locking check	<p>Couple 51S-1 Receiver to the 17.5-MHZ oscillator by placing the receiver antenna wire near oscillator tube 2A12V10.</p> <p>Set radio set control frequency selector knobs to any frequency between 2.000 and 6.999 MHZ.</p> <p>Tune 51S-1 Receiver to 17.5 MHZ.</p> <p>Ground test point (H3).</p> <p>Unground test point (H3).</p> <p>If indication is normal, proceed to step 11.</p>	<p>Oscillator will unlock and vary slightly from 17.5 MHZ.</p> <p>Oscillator should lock to 17.5 MHZ.</p>	Proceed to step 10B.
10B	2A10J3 (H3)  2A12J1 (J1)	17.5-MHZ oscillator phase-locking alignment	<p>Connect HP-410B VTVM DC probe to test point (H3).</p> <p>Adjust 2A12L90 until the 17.5-MHZ oscillator locks at 17.5 MHZ and the voltage at test point (H3) is +6.3 to +7.3 V.</p> <p>Connect type 340 voltmeter to test point (J1).</p> <p>Adjust 2A12T4 to peak voltage at test point (J1).</p> <p>Repeat step 10A.</p>	Phase locking restored.	Check 17.5-MHZ oscillator and MC frequency stabilizer 2A10.
11		HF oscillator phasing-locking check and alignment			
11A   (Cont)	2A12J7 (J7)  2A10J1 (H1)	HF oscillator phase-locking check	<p>Connect frequency counter (using no 1 probe) to test point (J7).</p> <p>Set radio set control frequency selector knobs, in turn, to each frequency listed in figure 8-69.</p> <p>Ground test point (H1) momentarily at each frequency.</p>	HF oscillator must unlock when test point is grounded: rellock to original frequency when test point is ungrounded.	Proceed to step 11B.

Figure 8-66. RF Translator 2A12, Module Checks and Adjustments (Sheet 8 of 26)

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STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
9B (Cont)	2A1J2 (A1)		Connect function test set J2-FREQ DIV jack to test point (A1).  Connect function test set GRND jack to radio receiver-transmitter chassis.		
	2A4J3 (D3)		Connect function test set J3-KC STAB jack to test point (D3), and place function test set FUNCTION SELECTOR switch in 70K-5 CAPTURE RANGE position.		
	2A12J8 (J8)		Ground test point (J8) to radio receiver-transmitter chassis.  Adjust R3 on function test set for a frequency indication between 3.5 and 4.0 KHZ higher than reference.  Without changing setting of function test set R3, unground test point (J8).  Ground test point (J8).  Adjust R3 on function test set for a frequency indication between 3.5 and 4.0 KHZ lower than reference.  Without changing setting of function test set R3, unground test point (J8).  Repeat above procedure with radio set control set to 2.000 MHZ. Reference indication should be 3.500 MHZ $\pm 0.8$ PPM (all other steps and indications should be identical).  Disconnect function test set.	Frequency indication should return to that of reference within 3 seconds.           Same as above.	Perform applicable step in KC frequency stabilizer 2A4 test procedures (figure 8-30).           Same as above.
9C  (Cont)		Alignment	If the VFO did not check out as in steps 9A and 9B, perform the following steps:  Leave frequency counter connected and ground test point (J8).		

Figure 8-66. RF Translator 2A12, Module Checks and Adjustments (Sheet 6 of 26)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
8 (Cont)			Repeat above procedure changing frequency from 2.100 to 2.200, to 2.110, and to 2.101.	Same as above.	Same as above.
9		VFO check and alignment			
9A	2A12J5 (J5)  2A12J8 (J8)	Tracking check	<p>Connect frequency counter through test probe no 1 (supplied in Electronic Equipment Maintenance Kit MK-825/ARM-86) to test point (J5).</p> <p>Ground test point (J8) to radio receiver-transmitter chassis.</p> <p>NOTE</p> <p>There are two CALIBRATION SETUP POINTS (frequency offset) stamped on the VFO case. Enter these points on the graph of figure 8-68. Connect the two points with a straight line drawn across the graph.</p> <p>Set radio set control frequency selector knobs to 2.999 MHZ, and record frequency counter indication on graph.</p> <p>Set radio set control frequency selector knobs to 2.000 MHZ, and record frequency counter indication on graph.</p> <p>Plot the midpoint frequencies of the VFO by setting the radio set control to 2.111, 2.222, 2.333, 2.444, 2.555, 2.666, 2.777, and 2.888 MHZ; record the frequency counter indication at each point.</p> <p>Unground test point (J8).</p>	<p>2.501 MHZ, + frequency offset, <math>\pm 1000</math> HZ from line on graph.</p> <p>3.500 MHZ, + frequency offset, <math>\pm 1000</math> HZ from line on graph.</p> <p><math>\pm 1</math> KHZ from line on graph.</p>	Perform VFO alignment (step 9C).
9B (Cont)	2A12J5 (J5)	Capture range check	Frequency counter remains connected to test point (J5). Set radio set control frequency selector knobs to 2.999 MHZ.	Frequency counter indication should be 2.501 MHZ $\pm 0.8$ PPM. Record this reading for reference.	

Figure 8-66. RF Translator 2A12, Module Checks and Adjustments (Sheet 5 of 26)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
4	2A12J5 J5	VFO output voltage check	Connect type 340 voltmeter to test point J5.  Check voltage at test point J5.	0.6 V (minimum).	Check VFO input level.
5	2A12J2 J2	Bandpass filter (low-frequency) check	Connect type 340 voltmeter to test point J2.  Key radio receiver-transmitter.  Check voltage at test point J2.  Unkey radio receiver-transmitter.	50 to 350 MV.	Check tubes and supply voltages.
6	2A12J3 J3	RF amplifier grid voltage check	Connect type 340 voltmeter to test point J3.  Key radio receiver-transmitter. Check voltage at test point J3.  Unkey radio receiver-transmitter.	From 50 to 200 MV.	Check 2A12S4 through 2A12S7. Align RF circuits (step 15).
7	2A12J4 J4	Driver grid voltage check	Connect HP-410B VTVM AC probe to test point J4.  Key radio receiver-transmitter.  Check voltage at test point J4.	Approximately 2.0 to 4.5 V.	Check and align RF circuits (step 15).
8    (Cont)	2A12J8 J8	Recycle line check	Connect HP-410B VTVM DC probe to test point J8.  Set radio set control frequency selector knobs to 3.100 MHZ, and key radio receiver-transmitter.  Reset radio set control frequency selector knobs to 2.100 MHZ.	VTVM should indicate approximately +33.0 volts DC.  VTVM should indicate 0.0 volt during recycle and return to approximately +33.0 volt DC upon completion of recycle.	Check 2A12K3, and chassis relay 2K4.

Figure 8-66. RF Translator 2A12, Module Checks and Adjustments (Sheet 4 of 26)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
1 (Cont)			<p>e. Connect RF TRANSLATOR LOAD, supplied in Electronic Equipment Maintenance Kit MK-825/ARM-86, to 2A12P2 and 2A12P3. Make this connection so that blue test point on RF TRANSLATOR LOAD is on the same side as 2A12P2.</p> <p>f. Connect HP-410B VTVM AC probe to blue test point on RF TRANSLATOR LOAD. Certain low-voltage signals may require a type 340 voltmeter.</p> <p>g. Unless otherwise specified, perform all steps with radio set control mode selector in AM, frequency selector knobs at 2.XXX MHZ, no signal in, and radio receiver-transmitter unkeyed.</p>		
2	2A12J1 (J1)	17.5-MHZ oscillator output check	<p>Connect type 340 voltmeter to test point (J1).</p> <p>Check voltage at test point (J1).</p> <p>Connect frequency counter to test point (J1).</p> <p>Check frequency at test point (J1).</p>	<p>0.9 V (minimum).</p> <p>17.5 MHZ <math>\pm</math>14 HZ.</p>	Check 17.5-MHZ oscillator and associated circuit.
3	2A12J7 (J7)	HF oscillator output check	<p>Connect type 340 voltmeter to test point (J7).</p> <p>Check voltage at test point (J7).</p> <p>Connect frequency counter to test point (J7).</p> <p>Check frequency at test point (J7).</p>	<p>0.6 V (minimum).</p> <p>12.5 MHZ <math>\pm</math>10 HZ.</p>	Check HF oscillator and associated circuit.

Figure 8-66. RF Translator 2A12, Module Checks and Adjustments (Sheet 3 of 26)

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
1 (Cont)			<p>Apply 115-volt, 400-HZ, 3-phase primary power to radio set test harness input power cable W20.</p> <p>Apply 115-volt, 60-HZ single-phase primary power to HVU blower power cable.</p> <p>Position radio set test harness POWER switch to ON.</p>	<p>Radio set test harness POWER lamp should light and radio receiver-transmitter blower should operate.</p> <div style="border: 1px solid black; padding: 5px; text-align: center; width: fit-content; margin: 10px auto;"><b>CAUTION</b></div> <p>Position POWER switch to OFF immediately if blower does not operate.</p>	<p>Repair or replace faulty POWER lamp and/or blower.</p> <p style="text-align: center;">NOTE</p> <p>Refer to Radio Set Test Bench AN/ARM-86 (TO 33D7-4-14-1) for repair procedures of faulty equipment contained in AN/ARM-86.</p>
(Cont)			<p>Position radio set control mode selector to AM.</p> <p style="text-align: center;">NOTE</p> <p>Allow 15 minutes for equipment to warm up.</p> <p style="text-align: center;">NOTE</p> <p>When necessary to use module extender, test setup is as follows:</p> <ol style="list-style-type: none"> <li>Connect RF translator 2A12 through module extender to radio receiver-transmitter chassis.</li> <li>Disconnect coaxial jumper at J34 on module extender.</li> <li>Connect signal generator, through 6-DB attenuator, to module input at J34 on module extender. Set signal generator to 500 KHZ.</li> <li>Remove block holding J30 and J31 on module extender. J30 and J31 mate with plugs 2A12P2 and 2A12P3.</li> </ol>		

Figure 8-66. RF Translator 2A12, Module Checks and Adjustments (Sheet 2 of 26)

8-294. Oscillator 2A12A2Q1 is tuned by variable inductor 2A12A2L2 which is mechanically varied by Autopositioner 2A12A1. The oscillator frequency is phase locked by voltage-sensitive capacitor 2A12A2C28. The DC voltage that tunes 2A12A2C28 is a combination of a mechanically adjustable bias supply in KC frequency stabilizer 2A4 and frequency and phase-sensitive control voltages from frequency and phase discriminators in KC frequency stabilizer 2A4. After the mechanical tuning is completed, KC frequency stabilizer 2A4 supplies a DC control voltage from the frequency discriminator to bring the VFO frequency within the capture range of the phase discriminator. The phase discriminator then superimposes a strong DC correction voltage to override the frequency discriminator and to phase lock the VFO to the reference frequency from RF oscillator 2A2. After the VFO is phase-locked, the phase discriminator constantly changes the control voltage to 2A12A2C28, if necessary, to keep the VFO frequency phase-locked with the reference. The VFO output signal is amplified and applied to the LF mixer in RF translator 2A12.

#### 8-295. TEST PROCEDURES.

#### 8-296. TEST SETUP.

8-297. Before interconnecting equipment, ensure that all primary power switches are placed in OFF position.

### WARNING

Before connecting the primary power cable to the bench, make sure that a ground strap is connected between the ground lug on the bench and the nearest ground point of the primary power source.

Interconnect test equipment as shown in figure 2-1. Deviations from the test equipment hookup diagram are covered in the test procedures. Test equipment required is listed in figure 3-1.

#### NOTE

Equivalent test equipment may be used.

#### 8-298. INITIAL CONTROL SETTINGS.

8-299. Refer to figure 6-8. Deviations from the initial control settings are covered in the test procedures.

#### 8-300. MODULE TEST PROCEDURE.

8-301. Perform the test procedures of figure 8-66 in the order given.

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
1		Initial test requirements	<p>Refer to figure 8-67 for location of all test points on RF translator 2A12.</p> <p>Remove RF translator 2A12 from radio receiver-transmitter chassis, and perform visual inspection.</p> <p>Remove dust cover from module to perform this test procedure.</p> <p>NOTE</p> <p>Unless otherwise specified, all steps are performed with radio set control mode selector set to AM, no signal in, and radio receiver-transmitter unkeyed.</p>		
(Cont)					

Figure 8-66. RF Translator 2A12, Module Checks and Adjustments (Sheet 1 of 26)

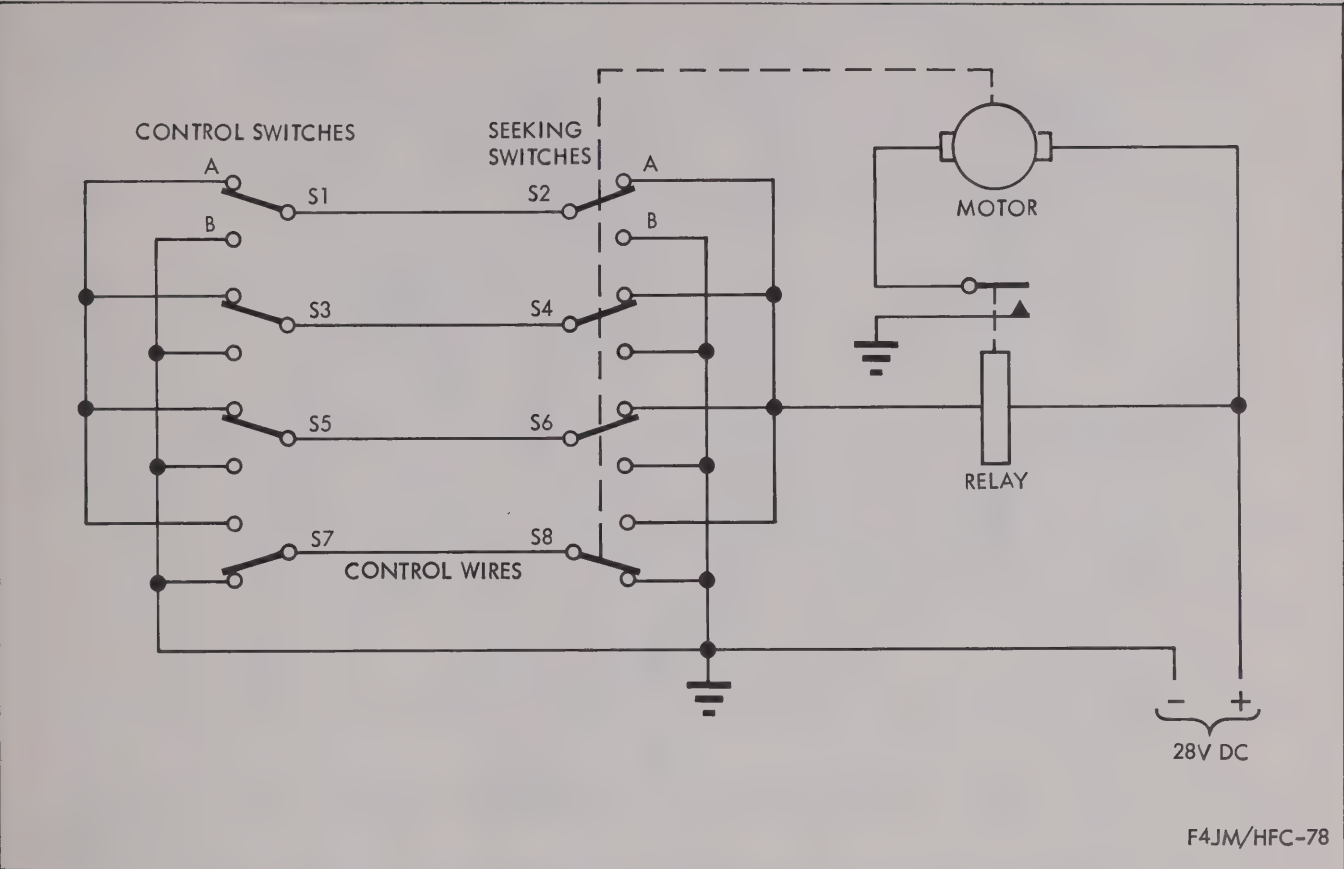


Figure 8-65. Frequency Control, Simplified Schematic Diagram

8-289. The total combinations of switch positions in such a system is  $2^n$ , where  $n$  is the number of control wires used. In the 4-wire system shown,  $n = 4$  and 16 different combinations exist. One combination is not usable. If all the seeking switches in figure 8-65 are set to the B position, there can be no path from the relay coil to ground, no matter how the control switches are set. The maximum number of usable combinations in such a system is  $2^n - 1$ . The 4-wire system shown can control 15 positions. The control switches for Autopositioner 2A12A1 are contained in the radio set control.

8-290. The output shaft of the Autopositioner is mechanically coupled to a variable inductor in the tuned circuit of VFO 2A12A2. Ten turns of the output shaft tune the VFO through a 1-MHZ frequency range (refer to figure 8-71).

8-291. The three seeking switches in Autopositioner 2A12A1 are 100-, 10- and 1-KHZ. To set up the selected VFO frequency, all three seeking switches must be properly positioned. Since each of the three switches has 10 positions, there are  $10^3$  or 1000 possible switch combinations or shaft positions. The 100-KHZ seeking switch is geared to the output shaft by an intermittent movement so that it is moved one position for each rotation (100 KHZ) of the output shaft. The 10-KHZ seeking switch and stop wheel

are coupled directly to the output shaft. The stop wheel has 10 notches, so that each notch position is separated from the next by 10 KHZ. The 100- and 10-KHZ seeking switches are both driven by motor 2A12A1B2. The 1-KHZ seeking switch is driven by a separate motor, 2A12A1B1, which also drives a gear and cam arrangement that turns the output shaft to 10 intermediate positions between each notch on the stop wheel. Each of the 10 positions is a 1-KHZ step. These 10 positions, together with the 100 notch positions furnished by the 10 rotations of the stop wheel, give the required 100 positions.

8-292. Autopositioner 2A12A1 mechanically tunes VFO 2A12A2 to within 2 KHZ of the selected operating frequency. The VFO is phase locked with the crystal-generated reference frequency from RF oscillator 2A2 by the action of circuits in KC frequency stabilizer 2A4. Precision resistive dividers, which are ganged to the seeking switches in the Autopositioner, furnish voltage information to the stabilizing circuits so that they will phase lock the VFO at the correct 1-KHZ frequency. As in the case of the 17.5-MHZ and HF oscillators in RF translator 2A12, the VFO is tuned by a voltage-sensitive capacitor.

8-293. The frequency of VFO 2A12A2 is controlled (through Autopositioner 2A12A1) by the 100-, 10- and 1-KHZ knobs on the radio set control. It is tuned in 1000 1-KHZ steps from 2.501 to 3.500 MHz.

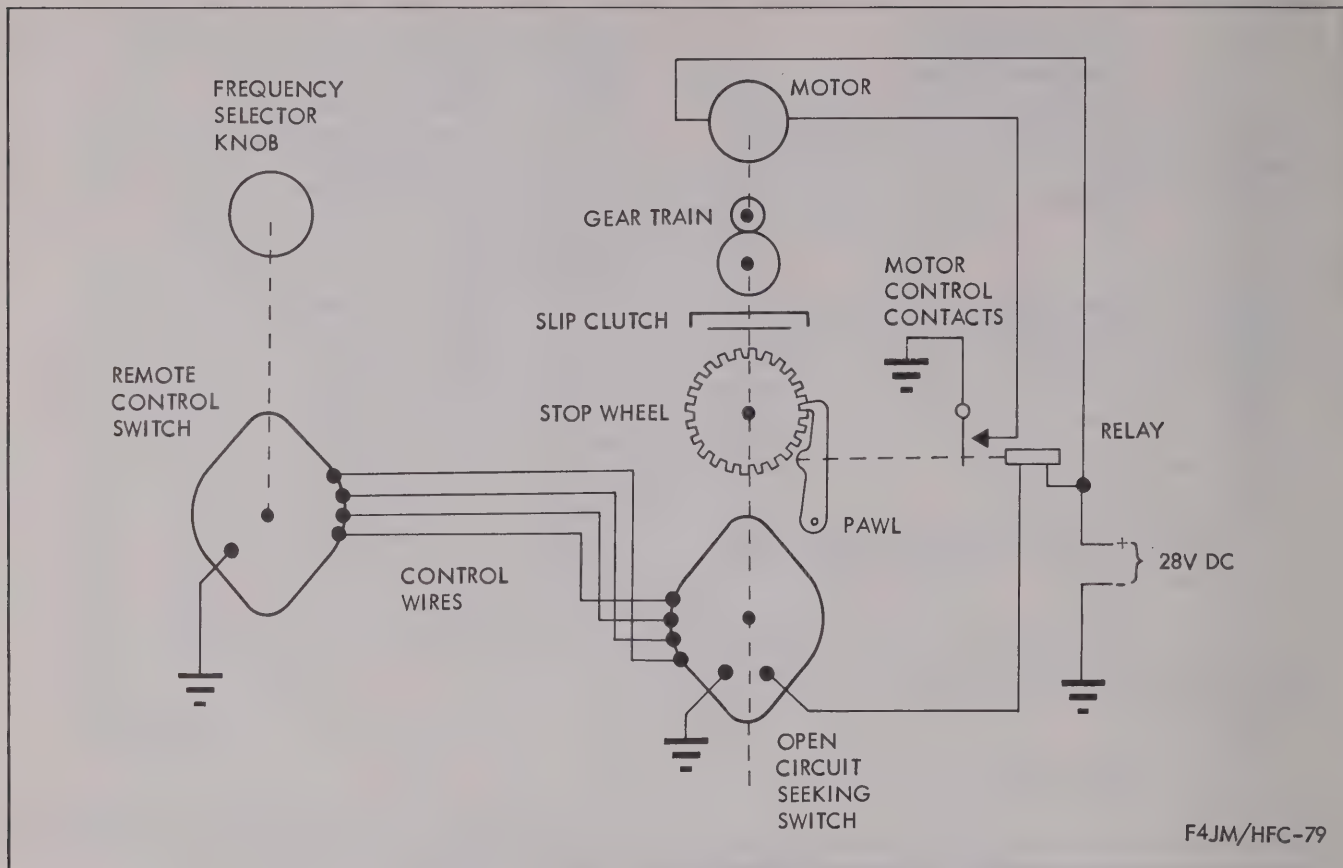


Figure 8-64. Autopositioner 2A12A1, Basic Elements Simplified Schematic Diagram

stop wheel, a pawl that engages the notches in the stop wheel, and a relay that controls the pawl and operates a set of electrical contacts to start and stop the motor. An electrical control system is part of each Autopositioner. This control system consists of remotely located control switches and related seeking switches driven by the Autopositioner shaft. Refer to figure 8-65. The control system is the open-circuit seeking type. When the control switches and seeking switches are not in the same electrical position, Autopositioner 2A12A1 is energized and drives its shaft (and the tuning elements to which the shaft is coupled) to the proper position and stops.

8-286. In a typical cycle of operation of Autopositioner 2A12A1, the system is at rest with the control and seeking switches in corresponding positions (open circuit), relay in the deenergized position, pawl engaging a stop-wheel notch, and the motor off. When the operator changes the setting of the frequency selector switches on the radio set control, the control system energizes the relay lifting the pawl out of the stop-wheel notch and closes the motor control contacts. The motor starts and drives the Autopositioner, shaft, the rotor of the seeking switches, and the tuning elements in the tuned circuits. When the seeking switch reaches the point corresponding to the new position of the control switch, the relay

circuit is opened, and the pawl is dropped into a stop-wheel notch. Shaft rotation stops, the motor control contacts open, and the motor coasts to a stop. The seeking switch of the control circuit is designed to open the relay circuit before the stop wheel reaches the point at which the pawl engages the proper notch. The relay contacts controlling the motor are adjusted so that they do not open until the pawl drops into the notch.

8-287. The radio set control provides a maximum number of tuning positions with a minimum number of control wires. This action is accomplished in the radio set control by using the control wires in various combinations.

8-288. Operation of the binary system is similar to that of single-pole, double-throw switches, as shown in figure 8-65. When the control and seeking switches are set as shown (switch 2A12A1S1 in the same position as switch 2A12A1S2, etc), there is no current path from the relay coil to ground, and the relay and motor are deenergized. If any of the control switches are set to a position opposite that of a corresponding seeking switch, a path to ground is closed, energizing the relay and motor. The motor turns the rotary seeking switches until they are again positioned in accordance with control switch positions. When this happens, the relay circuit opens, and the motor stops.

OPERATING RANGE (MHZ)	HF OSCILLATOR FREQUENCY (MHZ)	OPERATING RANGE (MHZ)	HF OSCILLATOR FREQUENCY (MHZ)	OPERATING RANGE (MHZ)	HF OSCILLATOR FREQUENCY (MHZ)
2-3	*12.5	12-13	15.0	21-22	**12.0
3-4	*11.5	13-14	16.0	22-23	**12.5
4-5	*10.5	14-15	** 8.5	23-24	**13.0
5-6	* 9.5	15-16	** 9.0	24-25	**13.5
6-7	* 8.5	16-17	** 9.5	25-26	**14.0
7-8	10.0	17-18	**10.0	26-27	**14.5
8-9	11.0	18-19	**10.5	27-28	**15.0
9-10	12.0	19-20	**11.0	28-29	**15.5
10-11	13.0	20-21	**11.5	29-30	**16.0
11-12	14.0				

\*These high-frequency oscillator frequencies are mixed with the 14.5- to 15.5-MHZ output from the 17.5-MHZ mixer.

\*\*These high-frequency oscillator frequencies are doubled before injection into the high-frequency mixer.

Figure 8-62. RF Translator 2A12, HF Oscillator Frequency for Each Operating Range

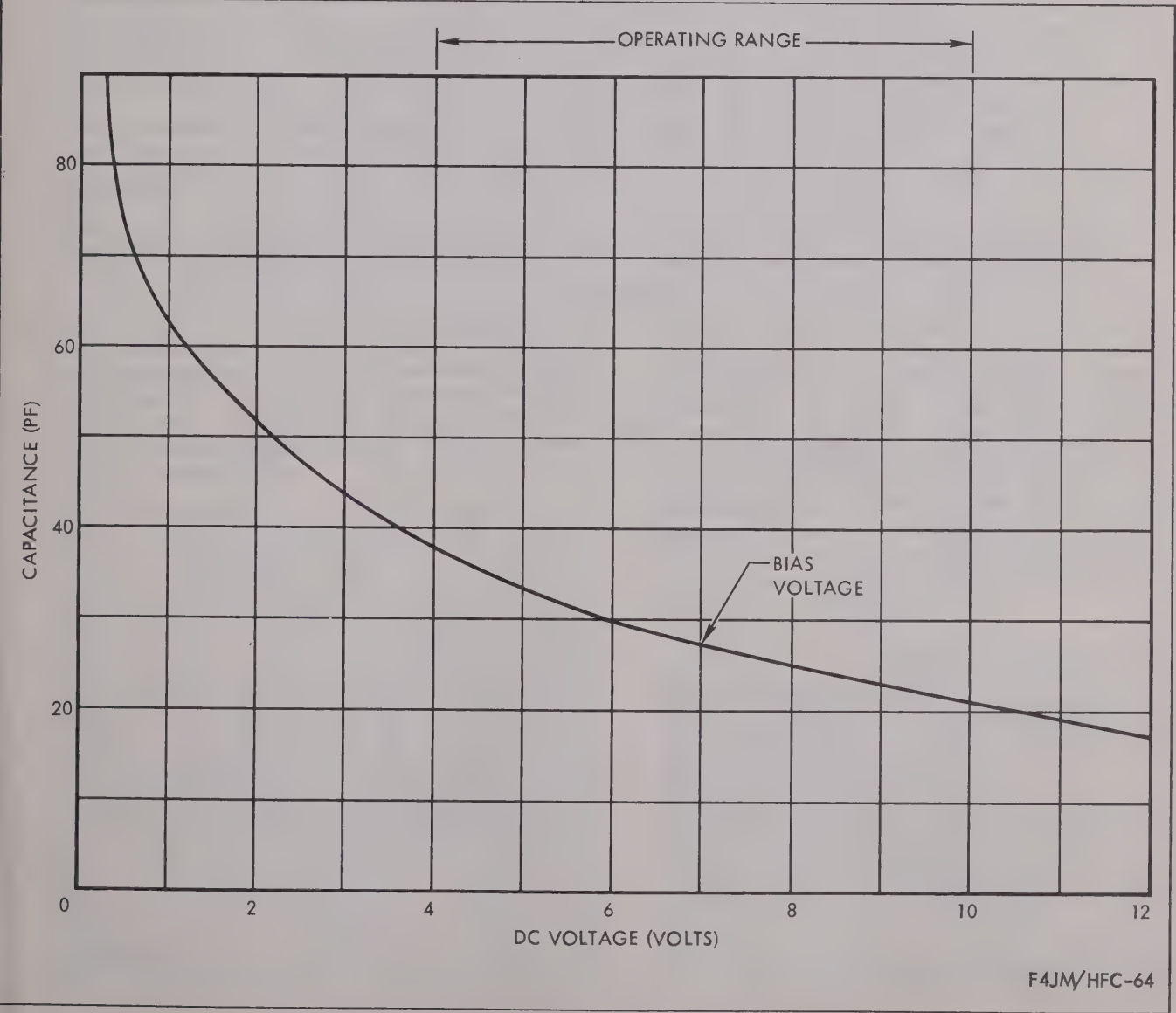
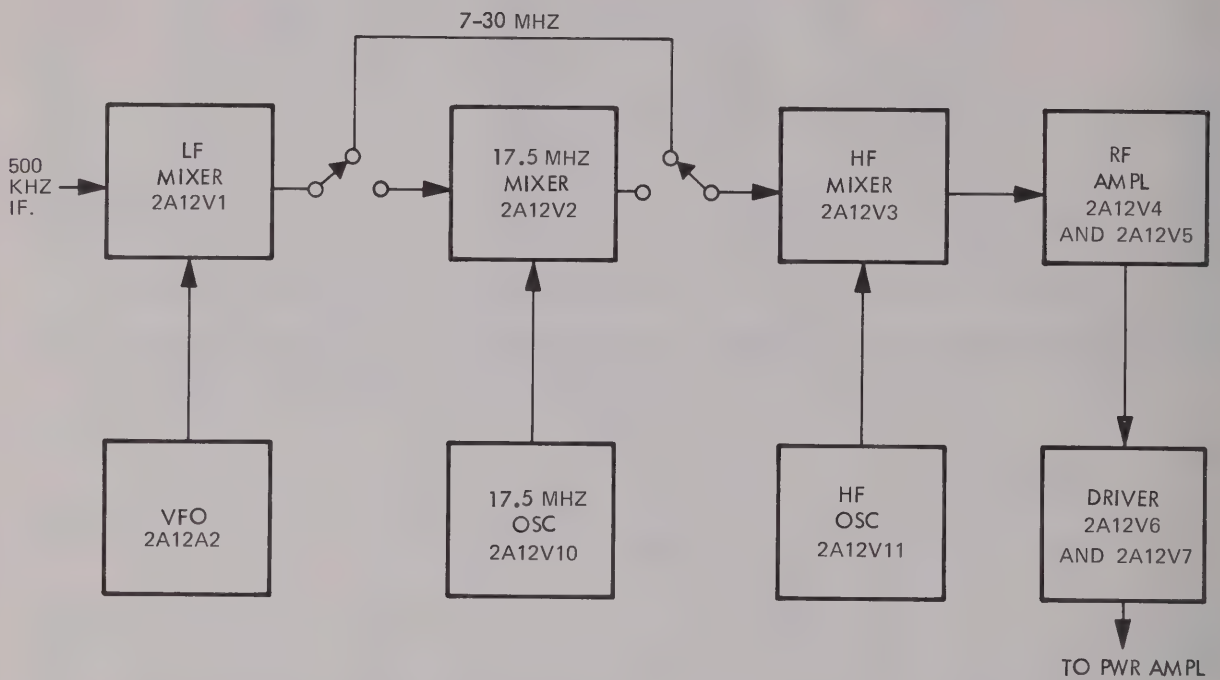
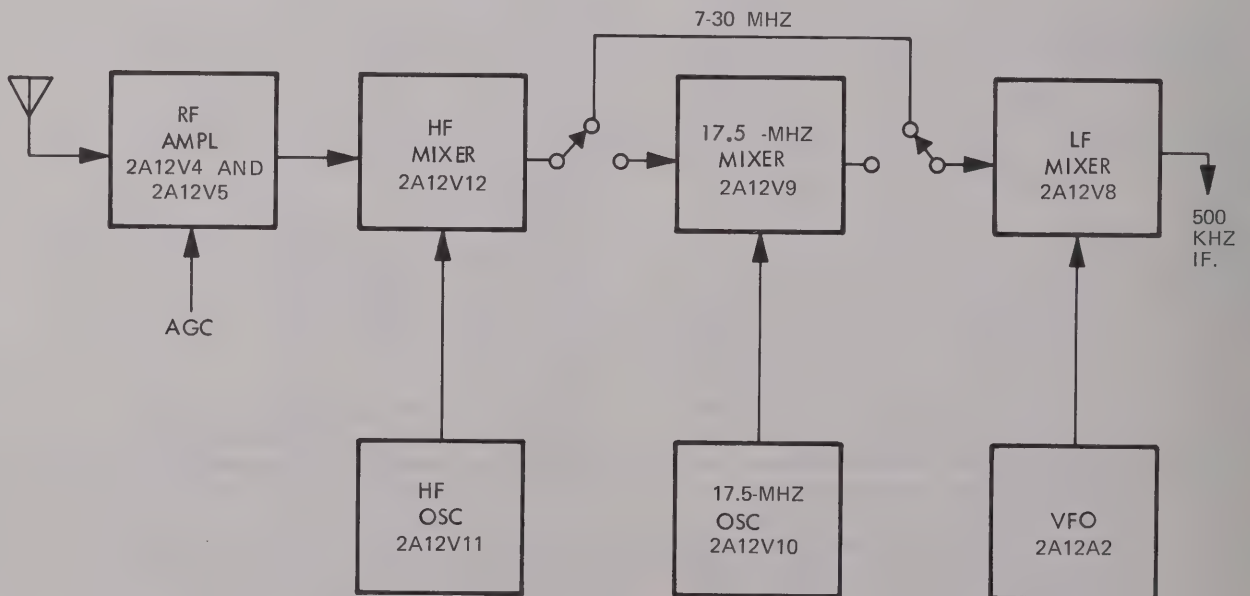


Figure 8-63. Typical Characteristics of Voltage-Sensitive Capacitor

### TRANSMIT



### RECEIVE



F4JM/HFC-59

Figure 8-61. RF Translator 2A12, Block Diagram

### 8-277. RF TRANSLATOR 2A12.

#### 8-278. CIRCUIT ANALYSIS.

8-279. GENERAL. In transmit, RF translator 2A12 transforms IF signals to RF signals for application to power amplifier 2A11. This module also receives RF signals from the antenna and transforms these signals to IF signals for use in the receiver portion of the HF radio system. RF translator 2A12 includes two submodules: Autopositioner 2A12A1 that tunes the circuits to a particular operating frequency, and variable frequency oscillator (VFO) 2A12A2 that produces injection frequencies for the low-frequency mixers in the receive and transmit functions.

8-280. BLOCK DIAGRAM ANALYSIS. (Refer to figure 8-61.) When RF translator 2A12 is in the transmit function, a 500-KHZ IF signal from IF translator 2A3 is combined with the VFO output at IF mixer 2A12V1. When the HF Radio Set is operating in the frequency range of 2.000 to 6.999 MHz, the output of the LF mixer is applied to 17.5-MHZ mixer 2A12V2. A signal from 17.5-MHZ oscillator 2A12V10 is mixed with the signal applied from the mixer. A 14.5- to 15.5-MHZ signal is produced and applied to HF mixer 2A12V3. However, if the HF Radio Set is operating in the range from 7.000 to 29.9999 MHz the output of the LF mixer is applied directly to HF mixer 2A12V3. HF oscillator 2A12V11 is capable of producing 28 frequencies, spaced 1 MHz apart. The desired frequency is mixed with the input signal of the HF mixer, and the output is applied to parallel-connected RF amplifiers 2A12V4 and 2A12V5. The amplified output is then applied to parallel-connected drivers 2A12V6 and 2A12V7 that apply an output to power amplifier 2A11. The injection frequencies from the HF oscillator for the 28 bands are tabulated in figure 8-62. The 28 frequencies provide 28 bands for the 1000 increments from the VFO, or 28,000 separate channels in all.

8-281. When the HF Radio Set is in receive function, the incoming RF signal is coupled to parallel-connected RF amplifiers 2A12V4 and 2A12V5. The amplified signal is then applied to HF mixer 2A12V12, where it is mixed with the desired signal from HF oscillator 2A12V11 as in the transmit function. The mixer signal is then applied to LF mixer 2A12V8, that heterodynes this signal with the VFO signal to produce a 500-KHZ IF signal. However, if the operating frequency range of the HF Radio Set is from 2.000 to 6.999 MHz, the output of the HF mixer is applied to the LF mixer through 17.5-MHZ mixer 2A12V9, where it is mixed with a signal from 17.5-MHZ oscillator 2A12V10. The RF amplifiers and LF mixer receive an automatic gain control voltage derived from the audio output, then is rectified and filtered by 2A9CR2 and 2A9CR13. In addition, the amplifiers and mixer are supplied with an automatic gain control voltage derived from diode 2A12CR6 which rectifies and filters a portion of the output from LF mixer 1A12V8. The 500-KHZ IF output signal from

the LF mixer is applied to IF translator 2A3 and AM/audio amplifier 2A9 for both SSB and AM IF amplification and detection.

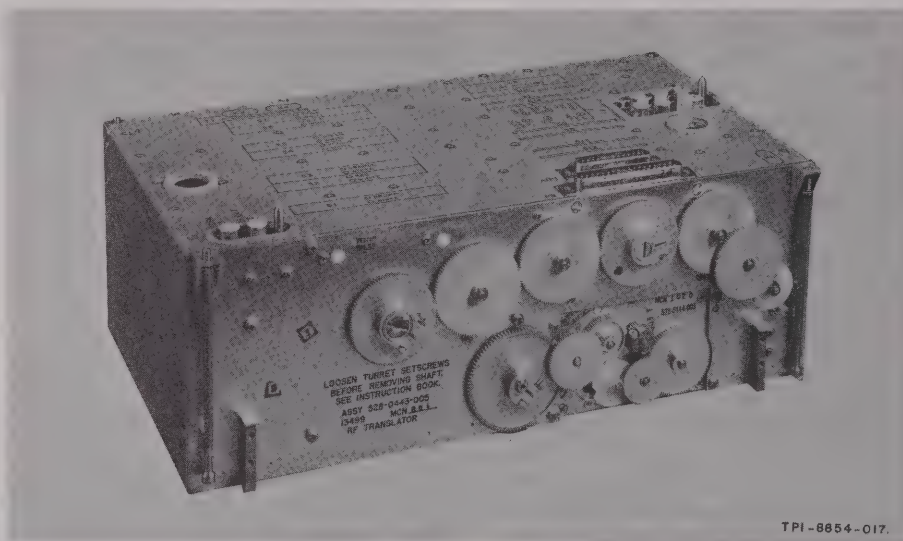
8-282. The frequencies of the 17.5-MHZ and high-frequency oscillators are frequency locked with the crystal-generated reference frequency from RF oscillator 2A2 by circuits in MC frequency stabilizer 2A10. These oscillators are tuned by voltage-sensitive capacitors, which are semiconductor devices whose capacitance varies as the DC voltage across them varies. A typical relationship between capacitance and DC voltages is shown in figure 8-63. A DC bias voltage is applied to the voltage-sensitive capacitor so that the voltage across it is varied by only a small amount.

8-283. DETAILED CIRCUIT ANALYSIS. (Refer to figures 8-70, 8-71, and 8-72.) When the HF Radio Set is in the transmit function, a 500-KHZ IF signal is applied to the grid of LF mixer 2A12V1. At this time, a signal is also applied to the cathode of the mixer. The two signals are mixed and applied to switch 2A12S8, that applies this signal to switch 2A12S9 or to the grid of 17.5-MHZ mixer 2A12V2, depending on the operating frequency of the HF Radio Set. The 17.5-MHZ mixer receives a 17.5-MHZ signal on both cathode and grid from 17.5-MHZ oscillator 2A12V10. If a signal is applied from switch 2A12S8 to the grid of the 17.5-MHZ mixer, this signal and the oscillator signal are mixed and applied to switch 2A12S9. This signal is applied to the grid of HF mixer 2A12V3, where it is mixed with a signal from HF oscillator 2A12V11. The output frequency of the HF oscillator is selected by switch 2A12S10, that selects one of 28 tuned coils that determine the tuned circuit connected to the grid of the tube. In the transmit function, relay 2A12K2 is energized, and signals are applied through switches 2A12S4 through 2A12S7 to the grids of parallel-connected RF amplifiers 2A12V4 and 2A12V5. Switches 2A12S4 through 2A12S7 make use of capacitors and inductors whose combinations are determined by the operating frequency. The signal is amplified by the RF amplifiers and transmitted to the control grids of parallel-connected drivers 2A12V6 and 2A12V7 where the signal is further amplified.

8-284. In the receive function, operation of the HF Radio Set is the reverse of the transmit function. Since the circuits are similar, refer to the detailed circuit analysis of the transmit function and the block diagram analysis of the receive function for a detailed description of this function.

8-285. CIRCUIT ANALYSIS OF AUTOPOSITIONER 2A12A1. Autopositioner 2A12A1 is a motor-driven, electrically controlled tuning mechanism that automatically tunes the transceiver to the frequency selected at the radio set control. As shown in figure 8-64, the basic elements of Autopositioner 2A12A1 are a motor and associated gear train, a slip clutch driving a rotary shaft fastened to a notched

**2A12**  
**RF TRANSLATOR**  
**THEORY AND MAINTENANCE**



RF TRANSLATOR 2A12

	Paragraph Number
CIRCUIT ANALYSIS	8-278
TEST PROCEDURES	8-295
TEST SETUP	8-296
INITIAL CONTROL SETTINGS	8-298
MODULE TEST PROCEDURE	8-300
TROUBLE ANALYSIS	8-302
DISASSEMBLY	8-304
INSPECTION, CLEANING, AND REPAIR	8-306
ASSEMBLY	8-308
MODIFICATION HISTORY	8-310

Figure 8-60. RF Translator 2A12, Maintenance Marker



3. Added 0.05-microfarad capacitor C301.
4. Moved 0.05-microfarad capacitor C157.
1. At REV LTR AS:
  1. Changed resistor R78 from 47 to 500 ohms (variable).
  2. Changed resistor R92 from 10K to 2200 ohms.
  3. Changed coil L82 from 2.2 millihenrys to 1 millihenry.
  4. Changed capacitor C6 from 330 to 300 picofarads.
  5. Changed VFO oven circuitry:
    - (a) Added 12-microhenry coils L41 and L122.
    - (b) Added 10-microhenry coil L131.
    - (c) Added 68-picofarad capacitor C261.
  6. Changed tube filament circuitry:
    - (a) Added 2.7-microhenry coil L133.
    - (b) Added 5.6-microhenry coil L134.
    - (c) Added 0.47-microhenry coil L135.
    - (d) Added 5.6-microhenry coil L136.
    - (e) Added 0.47-microhenry coil L137.
    - (f) Added 0.1-microfarad capacitor C279.
    - (g) Added 0.05-microfarad capacitors C282, C284, C285, C286, and C287.
  - m. Corrected location of J9.

8-313. AUTOPOSITIONER 2A12A1, MODIFICATION HISTORY. There have been no modifications to Auto-positioner 2A12A1.

8-314. VFO 2A12A2 MODIFICATION HISTORY. The modification history is as follows:

NOTE

Reference designations are abbreviated. Prefix designations with 2A12A2.

- a. Changed resistor R19 from 2200 to 3300 ohms.
- b. Changed resistor R22 from 330 to 150 ohms.

- c. Changed capacitor C17 from 510 to 22 picofarads.
- d. Changed resistor R12 from 8200 to 3300 ohms.
- e. Changed resistor R14 from 2700 to 3300 ohms.
- f. Changed transistors Q2 and Q3 from 2N2189 to 2N2861.
- g. Changed capacitor C10 from 180 to 1800 picofarads.
- h. Changed capacitor C8 from 82 to 180 picofarads.
- i. Changed transistor Q1 from 2N1197 to 2N2861.
- j. Changed capacitor C3 from 1200 to 360 picofarads.
- k. Changed resistor R1 from 1780 to 8250 ohms.
- l. Changed resistor R2 from 3830 to 8250 ohms.
- m. Changed resistor R3 from 4220 to 15,000 ohms.
- n. Added capacitor C23 from resistor R3 to coil L2.
- o. Changed resistor R13 from 8200 to 3300 ohms.
- p. Changed resistor R16 from 15,000 to 12,000 ohms.
- q. Changed resistor R17 from 18,000 to 6800 ohms.
- r. Changed resistor R18 from 2700 to 680 ohms.
- s. Changed resistor R10 from 2700 to 270 ohms.
- t. Changed resistor R9 from 12,000 to 4700 ohms.
- u. Capacitor C23 (220 picofarads) replaced by capacitor C29 (220 picofarads).
- v. Replaced circuit from transistor Q3 to capacitor C11 with resistor R23 (1000 ohms).
- w. Replaced circuit from transistor Q2 to capacitor C10 with coil L8 (56 millihenrys).
- x. Changed resistor R22 from 150 to 330 ohms.
- y. Added capacitor C30 (8 to 15 picofarads).
- z. Changed capacitor C9 from 620 to 1000 picofarads.
- aa. Added capacitor C31 (value selected in final test).
- ab. Changed note 5 test select values.
- ac. At CI 71113, changed transistors Q1 thru Q4 from 2N2861 to 2N3250.
- ad. Corrected note 3 and corrected note callout for C31.
- ae. At REV LTR BG, changed resistor R23 from 1K variable to 56 ohms.
- af. Restated note 6.
- ag. At REV LTR BH, changed C17 from 22 to 47 picofarads.

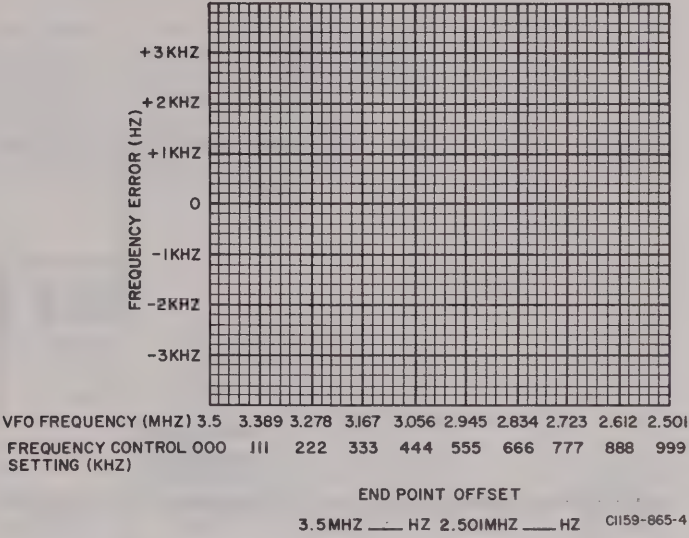
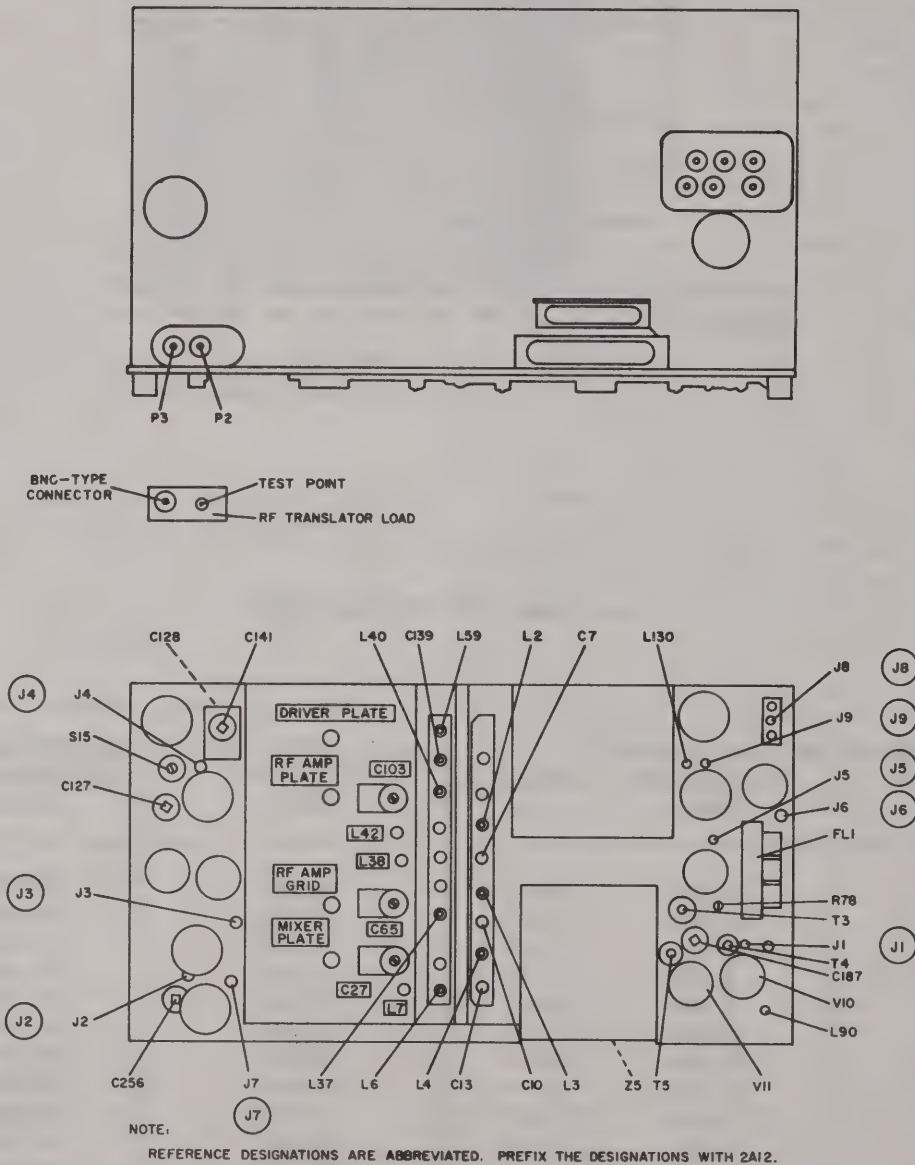


Figure 8-68. VFO Tracking Chart

RADIO SET CONTROL FREQUENCY (MHZ)	HF OSCILLATOR FREQUENCY (MHZ)	ADJUST	RADIO SET CONTROL FREQUENCY (MHZ)	HF OSCILLATOR FREQUENCY (MHZ)	ADJUST
2.XXX	12.500	Z5-2	16.XXX	19.000	Z5-16
3.XXX	11.500	Z5-3	17.XXX	20.000	Z5-17
4.XXX	10.500	Z5-4	18.XXX	21.000	Z5-18
5.XXX	9.500	Z5-5	19.XXX	22.000	Z5-19
6.XXX	8.500	Z5-6	20.XXX	23.000	Z5-20
7.XXX	10.000	Z5-7	21.XXX	24.000	Z5-21
8.XXX	11.000	Z5-8	22.XXX	25.000	Z5-22
9.XXX	12.000	Z5-9	23.XXX	26.000	Z5-23
10.XXX	13.000	Z5-10	24.XXX	27.000	Z5-24
11.XXX	14.000	Z5-11	25.XXX	28.000	Z5-25
12.XXX	15.000	Z5-12	26.XXX	29.000	Z5-26
13.XXX	16.000	Z5-13	27.XXX	30.000	Z5-27
14.XXX	17.000	Z5-14	28.XXX	31.000	Z5-28
15.XXX	18.000	Z5-15	29.XXX	32.000	Z5-29

Figure 8-69. Coil Block 2A12Z5, Adjustments



TPI-9302-014

Figure 8-67. RF Translator 2A12, Test-Point and Component Location

STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
11B		HF oscillator phase-locking alignment (perform this only if results of step 11A were abnormal)	<p>Place RF translator 2A12 on module extender supplied in Electronic Equipment Maintenance Kit MK-825/ARM-86.</p> <p>Perform setup procedure detailed in note in step 1 of this test procedure.</p> <p>NOTE</p> <p>The following adjustments are made at coil block 2A12Z5. Coils in this block may be adjusted through holes in RF translator 2A12 sideplate opposite gearplate. Refer to silk screening above adjustment holes for number and location of each coil in coil block.</p> <p>Connect HP-410B VTVM DC probe to test point (H1).</p> <p>Set radio set control to frequency at which the oscillator is unlocked. Refer to figure 8-69.</p> <p>Adjust the proper coil in 2A12Z5 until the HF oscillator locks at the correct frequency.</p> <p>Continue to adjust the coil until the voltage at test point (H1) is +6.3 to +7.3 V.</p> <p>NOTE</p> <p>If the coil core adjustment range is insufficient to lock the oscillator on any band, set that core flush with the block surface. Adjust the common (C) coil for proper lock. Whenever the core in the common (C) coil is repositioned, all individual band coils must be repositioned.</p> <p>When test is completed, remove RF translator 2A12 from module extender, and install 2A12 in radio receiver-transmitter chassis.</p>		
(Cont)	2A10J1 (H1)				

Figure 8-66. RF Translator 2A12, Module Checks and Adjustments (Sheet 9 of 26)

[illegible]

Figure 8-66. RF Translator 2A12, Module Checks and Adjustments (Sheet 10 of 26)

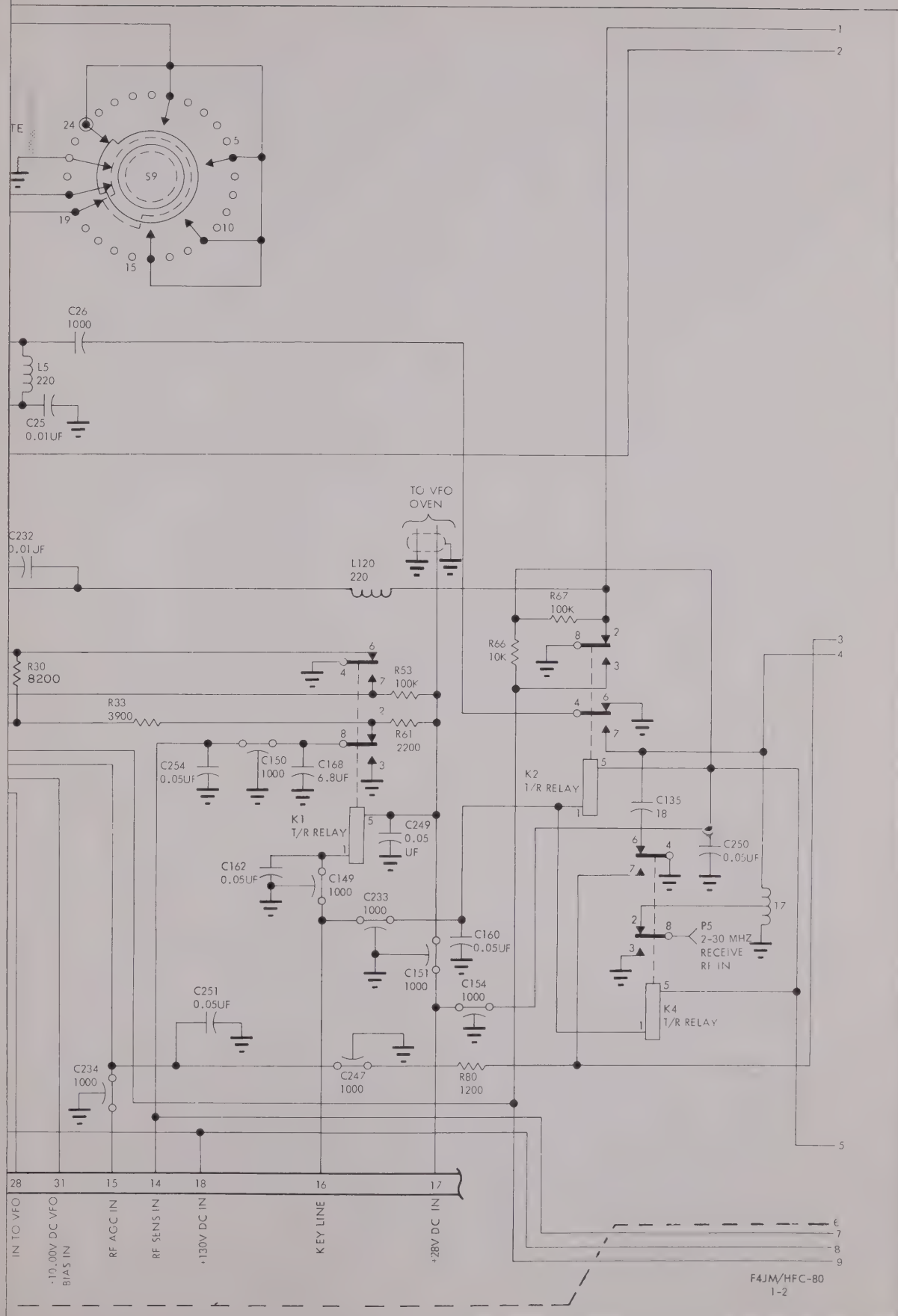


Figure 8-70. RF Translator 2A12, Schematic  
Diagram (Sheet 1 of 2)








STEP	TEST POINT	DESCRIPTION	TEST PROCEDURE	REQUIRED TEST RESULT	PROBABLE CAUSE OF ABNORMAL RESULT AND REMEDY
11B (Cont)	2A12J7 		<p>Connect Boonton 91-C RF VTVM to test point . Set radio set control frequency selector knobs to 6.XXX MHZ. Adjust bottom core in 2A12T5 to peak voltage at test point . Set radio set control frequency selector knobs to 14.XXX MHZ.</p> <p>Adjust top core in 2A12T5 to peak voltage at test point . Set radio set control frequency selector knobs to 29.XXX MHZ. Adjust 2A12C187 to peak voltage at test point .</p> <p>Repeat above three steps.</p> <p>Repeat step 11A.</p> <p style="text-align: center;">NOTE</p> <p>If the preceding adjustments fail to restore HF oscillator phase locking, refer to MC frequency stabilizer 2A10 checks and adjustments (figure 8-51).</p>		
12          (Cont)	2J6 	Receive IF output adjustment	<p>Set radio set control frequency selector knobs to 9.990 MHZ, mode selector to AM, and RF SENS control fully clockwise.</p> <p>Set radio receiver-transmitter AUDIO control fully clockwise.</p> <p>Connect HP-410B VTVM AC probe to radio set test harness HEADSET jack.</p> <p>Connect signal generator, through 6-DB attenuator, to test point .</p> <p>Set signal generator to 9.990 MHZ, 30% modulated with 1 KHZ.</p> <p>Adjust signal generator to provide 3 V at radio set test harness HEADSET jack.</p>		

Figure 8-66. RF Translator 2A12, Module Checks and Adjustments (Sheet 10 of 26)

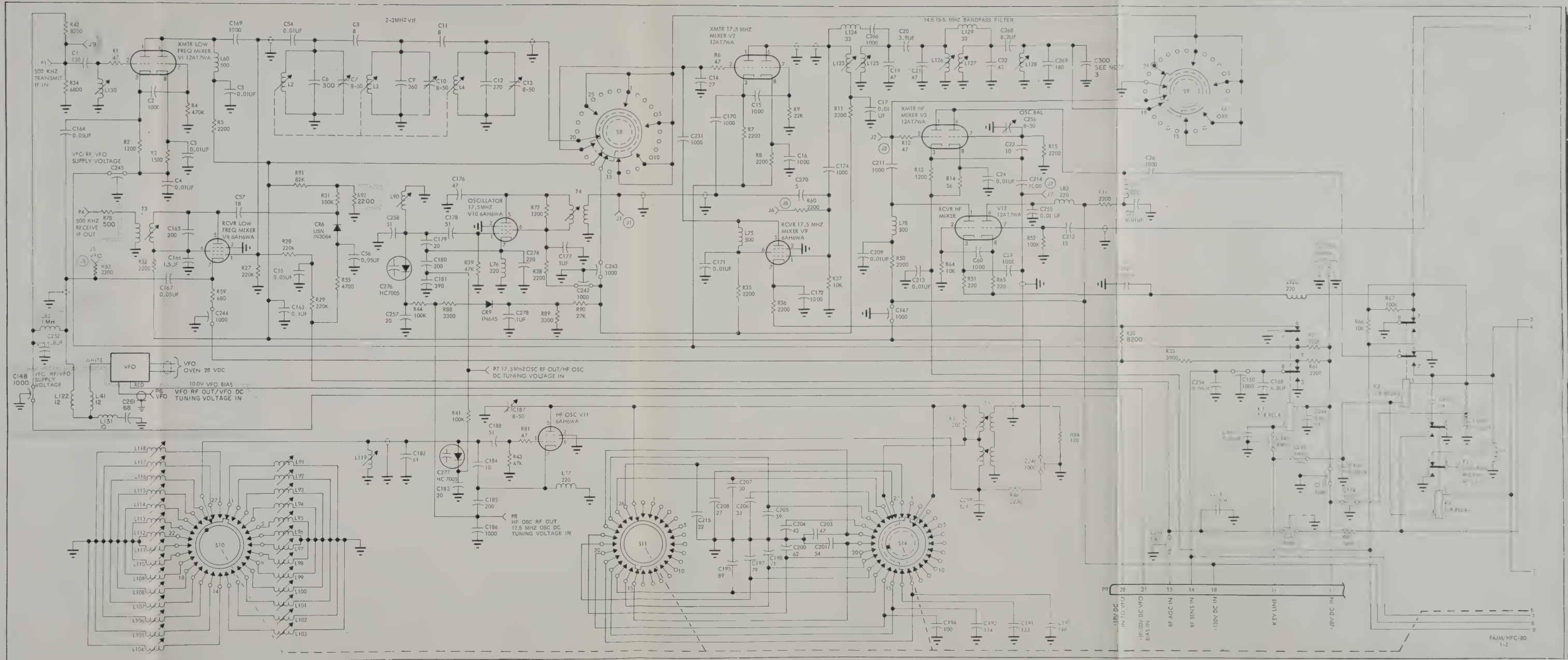


Figure 8-70. RF Translator 2A12, Schematic Diagram (Sheet 1 of 2)



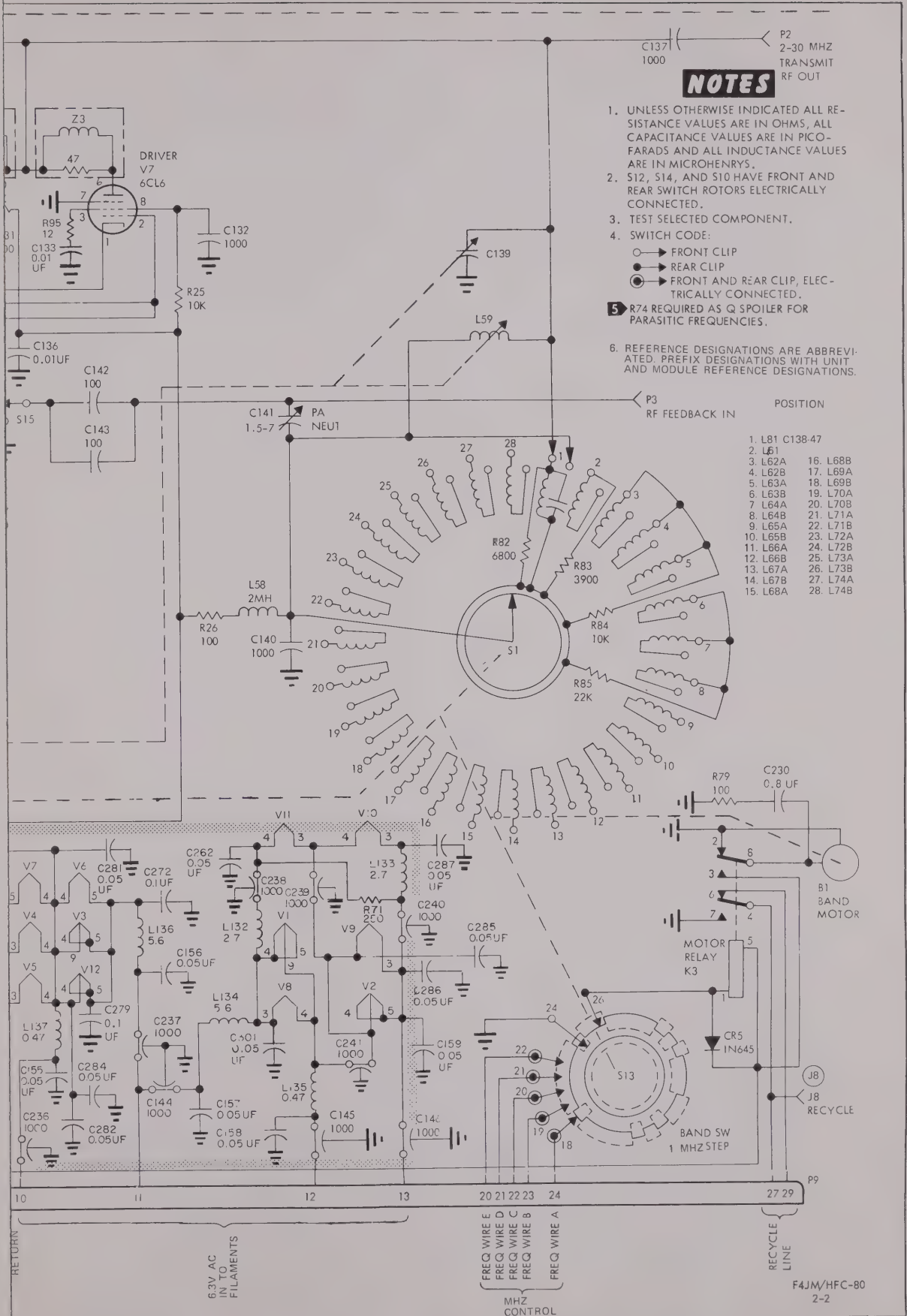


Figure 8-70. RF Translator 2A12, Schematic Diagram (Sheet 2 of 2)



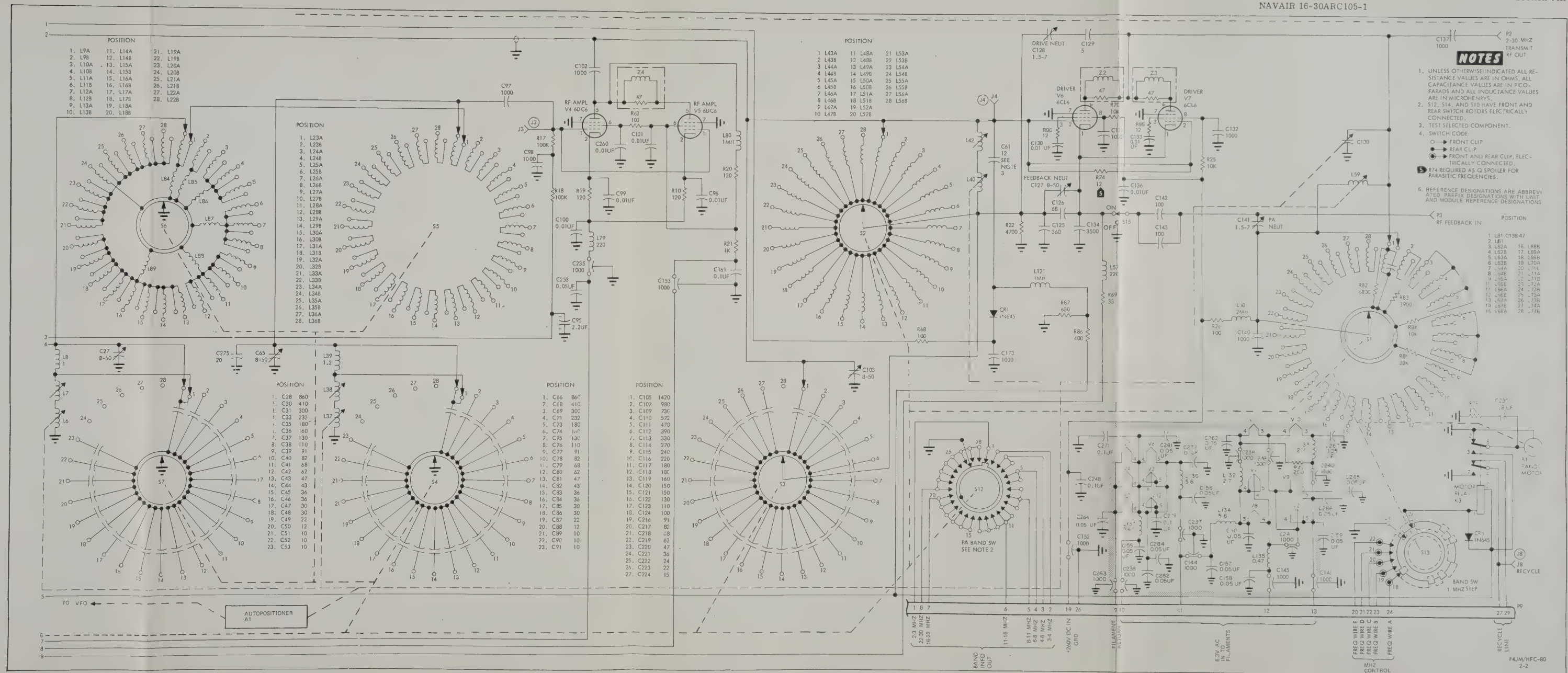


Figure 8-70. RF Translator 2A12, Schematic Diagram (Sheet 2 of 2)



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- b. Refer to paragraph 10-71. Check to see that actuating leaf of reversing switch is aligned properly.
- c. Refer to figure 10-7(B). Check that the gap between contacts 3 and 4 on solenoid relay (with pawl in notch) is at least 0.015 inch.
- d. Check that contacts 3 and 4 on solenoid relay are closed when pawl engages notched wheel by at least 0.005 inch.
- e. Check that gap between contacts 5 and 6 on solenoid relay (with pawl in notch) is at least 0.015 inch.
- f. Rotate the 1-KHZ cam by hand until hole in cam is adjacent to cam follower. Set frequency to X.000 MHZ, any MHZ band. Momentarily set the mode selector on the radio set control to USB, then back to OFF. While doing this, observe the direction of rotation of the camshaft from the gearplate side. When viewed from this side, the shaft must rotate counterclockwise.

**CAUTION**

Cam will be damaged if it rotates clockwise.

- g. Push the actuating leaf of reversing switch toward cam. Momentarily set the mode selector

switch on the radio set control to USB, then back to OFF. Clutch gear should rotate clockwise as viewed from gearplate side. With leaf in opposite position, clutch gear rotation should be in opposite direction. If directions of rotation are improper, rewire reversing switch as shown in figure 10-7(A).

- h. Attach calibrated disc and pointer supplied in Electronic Equipment Maintenance Kit MK-825/ARM-86 to Autopositioner 2A12A1 output shaft. Check that disc rotates one position for each 1-KHZ change in frequency, 10 positions for each 10-KHZ change, and one revolution for each 100-KHZ change.

10-79. TURRET ALIGNMENT. To align the turrets, proceed as follows:

- a. Refer to figure 10-12. Apply power to radio receiver-transmitter, and set operating frequency indicator on radio set control to 2 MHZ. Adjust turret drive shaft so that 2-MHZ turret contacts (identified by color coding) are centered on fixed contacts. Tighten clamp screw.
- b. Adjust band-switch shaft until clip of 2A12S12 is positioned as shown in figure 10-12. Tighten clamp screw.
- c. Recycle to the 2-MHZ position again, and re-check position of turret contacts and 2A12S12 clip as described above.

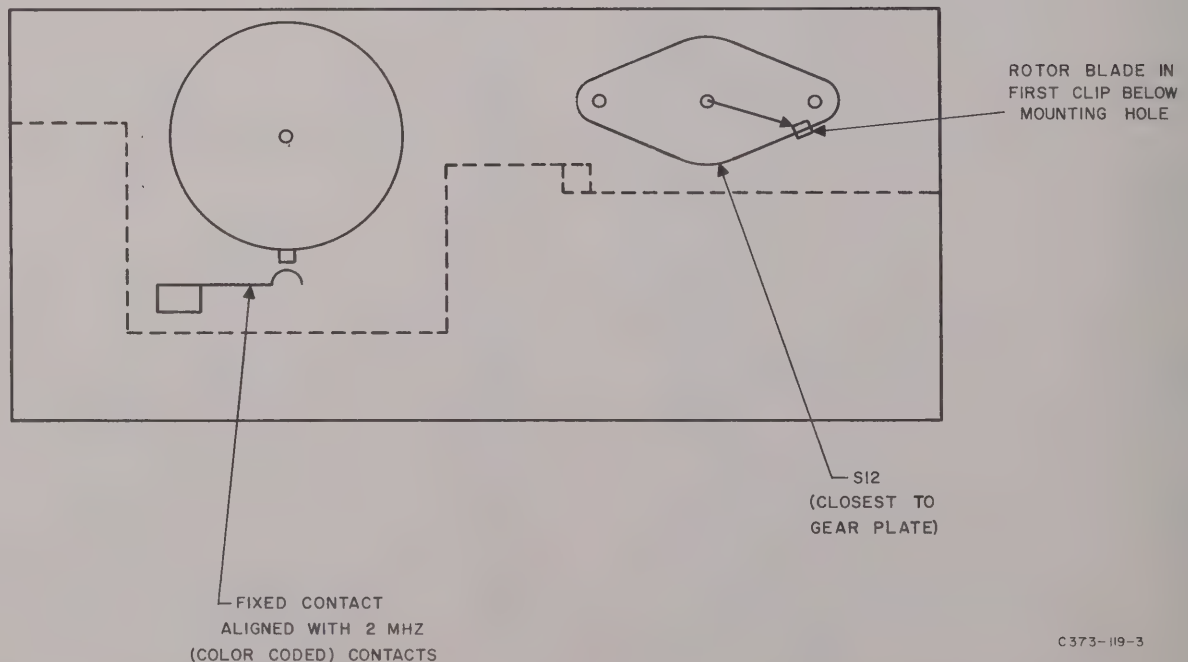


Figure 10-12. RF Translator 2A12, Switch and Turret Alignment

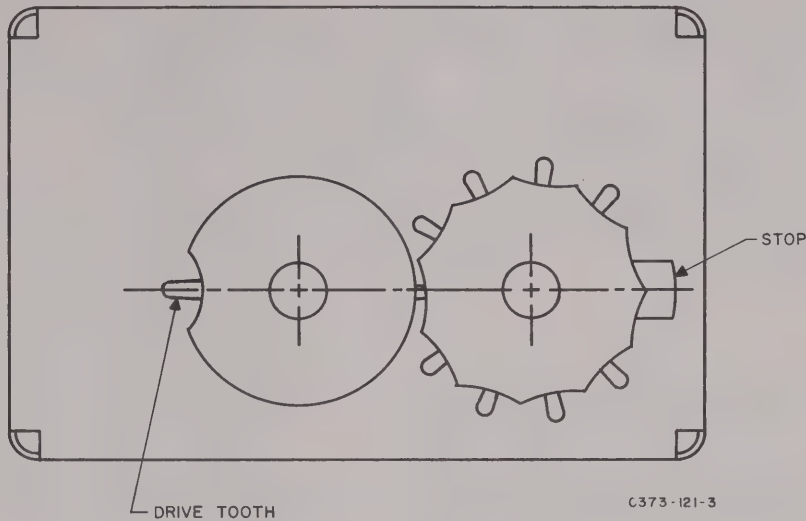


Figure 10-10. VFO in 500-KHZ Position

that each assembly is secure and properly seated. Inspect each assembly for loose parts, broken wires and hardware, and loose plugs and connectors.

10-75. LUBRICATION. Lubricate Autopositioner 2A12A1 as follows:

- a. Refer to figures 10-11 and 10-4. Lubricate gears (164) and (165) with grease. Apply grease sparingly and only on gear teeth.
- b. Apply grease very sparingly on all switches. Lubricate contact surfaces of clips and rotors.
- c. Apply grease sparingly to inside of spur gear (113).

NOTE

Do not get grease on clutch surfaces of this gear.

d. Lubricate all bearings with oil except spur gear (113).

10-76. Lightly lubricate bearings with oil (except porous bronze) in RF translator 2A12.

10-77. ALIGNMENT AND CHECK.

10-78. AUTOPOSITIONER 2A12A1 ALIGNMENT AND CHECK. This procedure is to be performed with Autopositioner 2A12A1 fastened to RF translator 2A12 module extender. Use special attachment supplied in Electronic Equipment Maintenance Kit MK-825/ARM-86 to fasten Autopositioner 2A12A1 to the module extender.

- a. Set the mode selector on the radio set control to OFF.

LUBRICANT	TYPE	GOVERNMENT DESIGNATION	MILITARY SPECIFICATION
Oil	Esso Univis P-38	WS-2397	MIL-L-6085A
Grease	Beacon 325		MIL-G-3278

Figure 10-11. Radio Receiver-Transmitter Lubricants

10-71. The Autopositioner reversing switch must be positioned with respect to the inspection hole so that the switch contacts make at the correct time. Refer to figures 10-4 and 10-9. Tighten the two screws (70) so that the switch actuator arm in its upper and lower dwell positions is the same distance from the corresponding edge of the inspection hole as determined by visual observation.

10-72. REPLACEMENT OF TURRETS. To replace turrets, proceed as follows:

a. Insert turrets in RF translator 2A12 from bottom of module so that all color-coded dots on turrets are in line at top of module.

#### NOTE

Each turret is marked with two color-code dots, one white and one a standard color-code color. The white dot is always nearest the gear plate. Turrets are color coded so that turret 2A12S1 is nearest gear plate. Therefore, color-code dots should be (from the gear plate): white, brown, white, red, white, orange, etc. When inserting a turret, orient it so that the spring contacts which project from the faces of the turret will not fall into the shaft holes when the turret is being positioned.

b. When all seven turrets are in place, replace turret shaft through gear that turns shaft. Before tightening shaft clamp, refer to paragraph 10-79 for turret alignment procedure.

c. Refer to figure 10-1. Replace two aligning rods (13) by inserting through gear plate. Secure rods with two screws through rear plate.

10-73. REPLACEMENT OF AUTOPOSITIONER 2A12A1 AND VFO 2A12A2. To replace these assemblies, proceed as follows:

#### NOTE

Be sure Autopositioner 2A12A1 is positioned to 500-KHZ before installing in RF translator 2A12.

a. Refer to figures 10-1, 10-2, and 10-3. Carefully maneuver Autopositioner 2A12A1 into place under gear plate. Place 25-pin connector (8) through 28-position switch to its position at bottom of module. Be careful not to damage switch wafers when placing connector through switch.

b. Replace four screws (11) holding Autopositioner 2A12A1 to gear plate. Leave screws loose one-half turn.

c. Position the two slug racks (12) at equal height above the chassis.

#### CAUTION

Make certain that the two slug racks are equal in height above the chassis. The slug rack has no stops, therefore, if racks are not positioned correctly at 500 KHZ, Autopositioner 2A12A1 could run beyond its design range, stretching and ruining the tapes.

With slug racks in this position, position clamp on slug rack gear so that it is facing top of module.

d. Replace idler gear (G9) that couples Autopositioner 2A12A1 gears to slug rack gear.

e. Position Autopositioner 2A12A1 in oversize mounting holes to remove as much backlash as possible in idler gear drive. Tighten four Autopositioner mounting screws (11).

f. Fasten 25-pin connector (8) to bottom of RF translator 2A12 chassis with two screws (10).

g. Replace three-eighths-inch flatted shaft (7) above 25-pin connector by placing it through gear that turns shaft.

h. Tighten clamp (9) that holds shaft.

i. Position VFO 2A12A2 shaft midway between end stops by positioning stop mechanism as shown in figure 10-10.

j. Place VFO 2A12A2 in its position under Autopositioner 2A12A1. Run three VFO leads (6) through holes in module chassis and resolder them.

k. Replace four tubes (5) adjacent to VFO 2A12A2 and Autopositioner 2A12A1.

l. Rotate rear brackets (3) on VFO 2A12A2 so that they can be fastened to rear plate.

m. Replace four screws (2) fastening VFO 2A12A2 brackets to rear plate and RF translator 2A12 chassis.

n. Place the coupling shaft alignment tool (fabricate per illustration in upper left-hand corner of figure 10-1) between the coupling disc on VFO 2A12A2 shaft and the brass center disc. Press the coupling disc snugly against the gauge, and tighten the two setscrews of the coupling disc.

#### CAUTION

Use of the 0.10-inch coupling shaft alignment tool is required for optimum mechanical adjustment. The allowable tolerance between the coupling faces is 0.005 inch to 0.015 inch. An excessive gap (above 0.015 inch) will reduce tuning reset accuracy due to backlash; not enough gap (below 0.005 inch) will cause mechanical distortion to be transmitted to the VFO tuning element, resulting in poor (non-linear) tracking.

10-74. VISUAL CHECK. After replacing all assemblies in the RF translator chassis, check to see

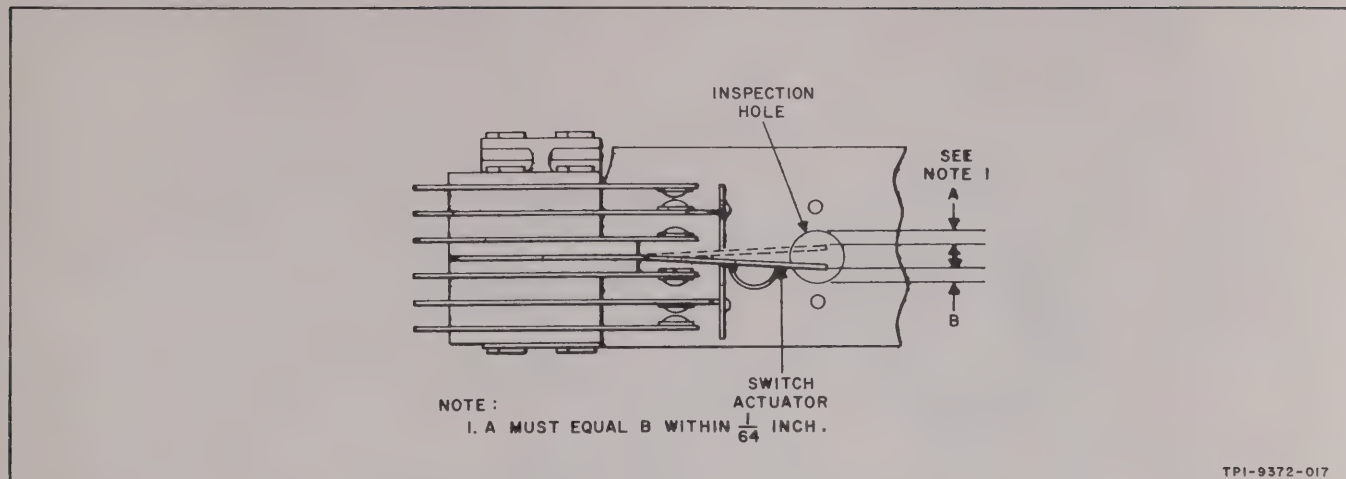


Figure 10-9. Autopositioner 2A12A1, Reversing Switch Positioning

e. Replace reversing switch (68) using two screws (70). Be sure leaf is in slot in reversing switch pawl (100).

f. Replace cable clamp (71) using screw (72) and washer (73).

g. Place switch assembly in Autopositioner 2A12A1 chassis. Be sure to place any shim washers which were removed earlier over shaft before inserting shaft through gearplate. Be sure spur gear (113) meshes with gear (164).

h. Replace cable clamp (25) using screw (26).

i. Replace resistor (18) on gearplate using screw (19) and washers (20, 21, 22). Position resistor terminals so that they are parallel to long sides of gearplate.

j. Perform steps a through j of paragraph 10-69.

10-69. Replace the 1-KHZ switches as follows:

a. Resolder any cable wires or wires connecting wafers that were removed during disassembly. Use figure 10-8(B) as a guide.

b. Replace all ceramic spacers (44) and fiber washers (42) between switch wafers. Fasten wafers together and to bearing plate with two screws (41).

c. Rotate gear (5) or (9) by hand to position control cam (37) so that cam follower (142) is as near cam-shaft (39) as possible.

d. Place bearing plate (169) in position at ends of mounting posts (148). When sliding camshaft (39) through 1-KHZ switch wafers, be sure that both wafers are aligned as shown in figure 10-7(C). Tighten bearing plate using four screws (149).

e. Replace DC motor (158) and motor mount (159) on bearing plate using two screws (160) and two washers (161).

f. Replace relay (155) on bearing plate using two nuts (156) and two washers (157).

g. Replace two cable clamps (162) using two screws (163).

h. Replace VFO coupling shaft (61) on output shaft (120) by tightening two setscrews (60).

i. Replace output shaft spur gear (15) using set-screw (14) in clamp (13). Be sure this gear has maximum face-width engagement with gear (11).

j. Replace spring (146) by hooking bar (147) in slots on mounting posts (148). Hook free end of spring first.

k. Refer to paragraph 10-78 for Autopositioner alignment, and check procedure before replacing 2A12A1 in RF translator 2A12 chassis.

10-70. Replace reversing switch (68) as follows:

a. Resolder the six wires connected to switch (68).

#### NOTE

Be sure switch leads are positioned so there is clearance for switch assembly to rotate.

b. Replace switch (68) in mounting plate (145) (brass plate side against tension clip). Be sure switch leaf is in slot in reversing switch pawl (100).

c. Replace two screws (70) through switch (see paragraph 10-72 before tightening).

d. Replace cable clamp (71) using screw (72) and washer (73).

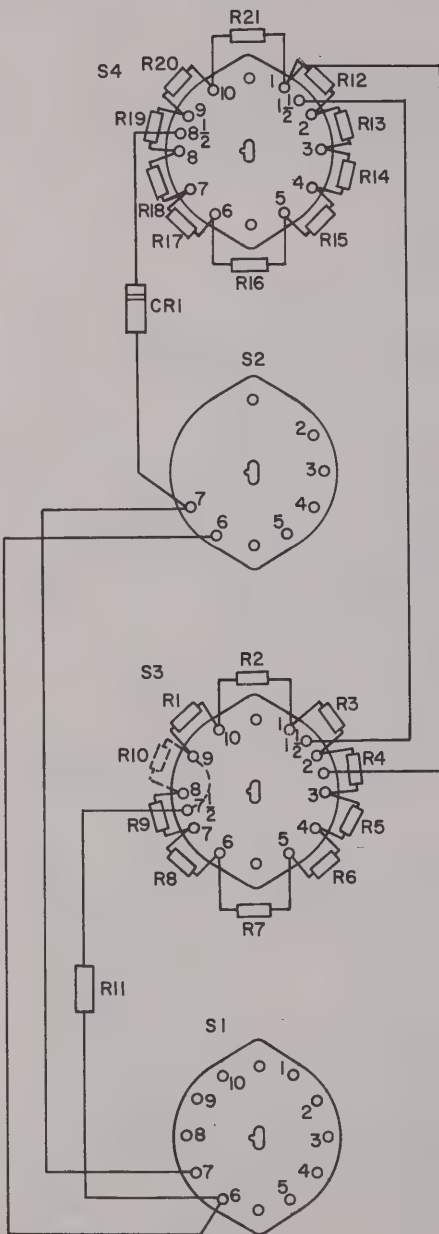
e. Replace cable clamp (25) using screw (26).

f. Replace spring (146) by hooking bar (147) in slots on mounting posts (148). Hook free end of spring in place first.

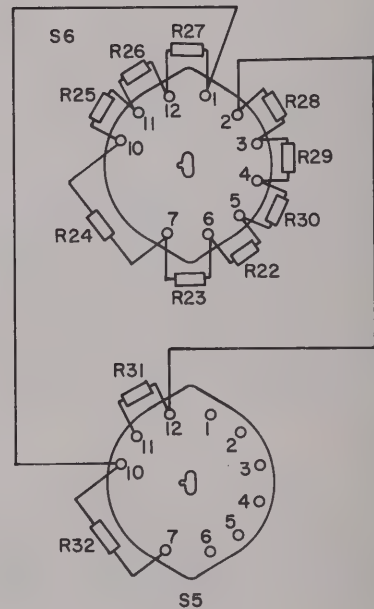
#### NOTE

Check again to see that switch leads are positioned so that there is clearance for switch assembly to rotate.

g. Refer to paragraph 10-71 for Autopositioner reversing switch positioning before replacing submodule in RF translator 2A12.



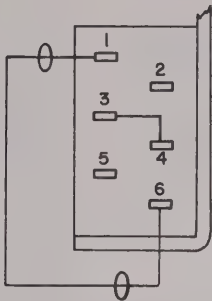
(A) 10 KHZ SWITCHES



(B) 1 KHZ SWITCHES

C373-142-4

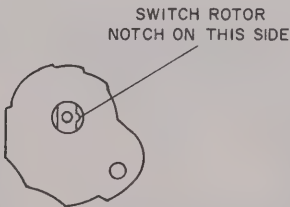
Figure 10-8. Autopositioner 2A12A1, Switch Identification



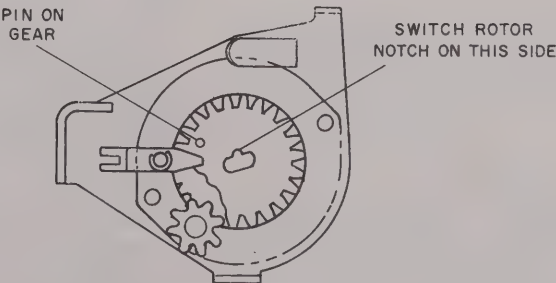
(A) REVERSING SWITCH TERMINAL IDENTIFICATION



(B) SOLENOID RELAY TERMINAL IDENTIFICATION



(C) 1 KHZ. SWITCH ALIGNMENT



(D) 10 KHZ SWITCH ALIGNMENT

C373-143-3

Figure 10-7. Autopositioner 2A12A1, Alignment

#### 10-61. REASSEMBLY OF MECHANICAL ASSEMBLIES.

10-62. The following paragraphs describe the re-assembly procedures for the dismantled or dis-assembled units of the HF Radio Set.

10-63. POWER AMPLIFIER 2A11. To reassemble power amplifier 2A11, refer to figure 10-5, and proceed as follows:

a. Replace gearplate by sliding band-switch shaft through the switch. Be sure that lower strap is inserted under the securing screw washers when gearplate is pushed into place.

#### NOTE

If shaft is not chamfered on end, chamfer slightly before replacing.

b. Tighten screw securing lower strap to roller coil assembly. Resolder power resistor to gearplate terminal.

c. Replace screw and washer holding the large silver-plated coil to roller coil assembly. Use hole nearest gearplate.

d. Replace two nylon screws and washers holding the roller coil assembly to bracket near tubes. Damage will result if screws are secured too tightly.

#### CAUTION

Bend the screw bypass capacitor down to cover the screws just replaced. If capacitor is not positioned correctly, plate strap will arc to capacitor.

e. Replace square plate on rear of module using eight screws.

f. Replace top cover plate by laying it in position, pushing it toward rear of module, and tightening 17 screws.

g. Replace the screws (S) on gearplate.

10-64. RF TRANSLATOR 2A12. To reassemble RF translator 2A12, perform the procedures of paragraphs 10-65 through 10-74.

#### 10-65. AUTOPOSITIONER 2A12A1 ASSEMBLY.

10-66. Replace solenoid (128) as follows. Refer to figure 10-4.

a. Replace solenoid (128) on mounting plate (145) using two screws (129) and mounting post (127). Be sure mounting post (127) is in correct hole. Align solenoid (128) so that its shaft is lined up with shaft hole in mounting plate (145) before tightening screws.

b. Solder insulated jumper from solenoid relay terminal 6 to solenoid terminal 2. See figure 10-7(B).

c. Replace retaining ring (124) on output shaft (120).  
d. Replace armature (121) on solenoid (128) using two screws (122).

#### NOTE

Be sure these two screws (122) are the same as those removed during disassembly. If screws are lost, they must be replaced with screws having the same color code.

e. Replace hub notched wheel (114) on output shaft (120). Replace spring pin (115) through hole in nut and shaft.

f. Replace small fiber actuator (130) between armature (121) and solenoid relay contacts. See figure 10-7(B) for proper placement of actuator.

g. Perform steps a through c of paragraph 10-67.

10-67. Assemble the clutch assembly as follows:

a. Replace spur gear (113) and clutch disc (112).

#### CAUTION

Do not lubricate or clean clutch surfaces (112, 113, or 114). Wipe only with dry, clean, lintless cloth. Do not touch clutch surfaces with fingers.

b. Replace spring washer (111) with concave side against clutch disc (112). Replace washer (110) and nut (109).

c. Tighten nut (109) until 30 to 40 inch-ounces of torque is needed to slip spur gear (113). This torque can be measured with a Waters torque watch, model 651C-3, or equivalent. Attach torque watch to end of output shaft (130). Hold spur gear (113) stationary and rotate watch. Adjust nut (109) until proper torque is indicated on torque watch. Bend two tabs on washer (11) against flats on nut (109) when clutch is properly torqued.

d. Perform steps a through j of paragraph 10-68.

10-68. Replace the 10- and 100-KHZ switches as follows:

a. Position switch wafers on shaft so that they are oriented as shown in figure 10-7.

b. Resolder any cable leads that were unsoldered during disassembly. Use figure 10-8(A) as a guide when replacing wires which connect switch wafers.

c. Replace all metal spacers (86, 99) between switch wafers. Fasten wafers together and to mounting plate (145) with two screws (82) and washers (83).

d. Replace the six solenoid leads, which were unsoldered earlier, through hole in mounting plate (145). Resolder these six wires to solenoid (128) and solenoid switch block (138). See figure 10-7(B). Retie these wires.

10-45. Inspect rotary switches as follows:

- a. Inspect insulation for cracks, breaks, or charring.
- b. Check movable and stationary contacts for deformation, breakage and wear, and for burning, pitting, and corrosion.
- c. Inspect terminals for loose, poorly soldered, broken, or corroded connections.
- d. Examine mechanical parts for damage or corrosion and for irregular or rough action.

10-46. Examine transformers and reactors for signs of excessive heating, physical damage to case, cracked or broken insulators, and other abnormal conditions. Also check for corroded, poorly soldered or loose terminals, and loose, broken, or missing mounting hardware.

10-47. Inspect tube sockets, tubes, and tube shields as follows:

- a. Check tube sockets for cracked, broken, or charred insulation.
- b. Examine tube sockets for broken, deformed, or corroded contacts, and loose, poorly soldered, broken, or corroded terminal connections.
- c. Examine tube envelope for cracked glass and obliterated markings. Check socket end for crazed glass surrounding tube pins. Check for deformed pins and correct with tube pin straightener tool if misalignment and bends are minor.
- d. Examine tube shields for dents or corrosion near base. Check for presence of retaining spring and proper spring seating.

10-48. Check open and laced wiring on chassis, terminal boards, and parts of equipment by checking insulation for physical damage and charring. Examine wires for breakage and for improper dress in relation to adjacent wiring or chassis. Examine for broken strands and incomplete soldering at terminations.

#### 10-49. REPAIR AND REPLACEMENT.

10-50. GENERAL.

10-51. The following paragraphs contain information for repair and replacement of printed circuit boards and the repair and replacement of detail parts which normally can be overhauled. Detailed parts which are malfunctioning are usually located by visual inspection procedures. Repair of items not considered economically feasible is not given. Repair of most detail parts consists of cleaning. See paragraph 10-22 for information on cleaning procedures.

10-52. RADIO RECEIVER-TRANSMITTER CHASSIS CABLING REPAIR.

10-53. When it is necessary to repair the chassis cabling, care should be exercised to replace the wiring with wire of the same size and with the same color coding. When repair is completed, a check should be made to assure that the cable is still

10-12

wired correctly. This may be done by performing a continuity check.

10-54. PRINTED CIRCUIT BOARD REPAIR.

10-55. Parts mounted on printed circuit boards are to be removed as follows:

- a. Apply a hot soldering iron of not more than 25-watt rating to melt the solder surrounding the point. Remove the wire or component from the tubelet.
- b. If necessary, remove the excess solder from the joint with a soldering iron.

#### CAUTION

Be careful not to damage circuits when removing detail parts from printed circuit boards. Each wire or detail part lead is bent sharply across each tubelet edge. The wire must be straightened before wire or detail-part removal can be accomplished.

c. Insert new wire or component in the correct tubelet, and clinch the wire over the tubelet.

d. Apply solder and soldering iron to the joint to melt the solder and heat the joint at the same time. Do not keep the iron on the joint longer than necessary to complete solder flow throughout the joint.

#### CAUTION

Use solder with rosin flux core. Any rosin flux solder approved under QQ-S-571 may be used. Do not use solder that has a core of hydrazine, acid, or other unapproved flux.

e. Clean the joint with stiff-bristled brush and a small amount of solvent as specified in paragraph 10-26. Remove solvent and dissolved flux with absorbent material.

10-56. SWITCH REPAIR.

10-57. All rotary switches located in the radio receiver-transmitter should be cleaned according to the procedures given in paragraph 10-30. All rotary switch wafers should be replaced if any individual switch contact becomes faulty from excessive wear, misalignment, or poor contact pressure.

#### 10-58. REASSEMBLY AND REPLACEMENT.

10-59. GENERAL.

10-60. The following paragraphs contain assembly instructions.

10-30. Clean rotary switches as follows:

- a. Remove all dust with air jet, turning switch rotor back and forth several times while blowing.
- b. Wash all contacts and insulation with alcohol applied lightly with small camel-hair brush.
- c. Dry with air jet, then repeat wash using clean alcohol and rotating switch rotor several times during this wash.
- d. Dry gently but thoroughly with air jet.

10-31. Clean metal parts and gears as follows:

- a. Remove bulk of any surface grease with rags.
- b. Blow dust from surfaces, holes, and recesses with air jet.
- c. Immerse the part in a washing bath of solvent, and scrub until clean. Clean all surfaces and recesses with a nonmetallic brush.
- d. Raise from bath and drain.
- e. Immerse in a rinsing bath of clean solvent. Raise from bath and drain dry.

10-32. Clean printed circuit boards as follows:

- a. Use an air jet and camel-hair brush to blow and brush dust and dirt from surfaces, holes, and crevices.
- b. Wipe clean with a lintless cloth which has been slightly moistened with solvent.

10-33. For touchup painting of cover or chassis case, use silicone aluminum heat resistant baking paint per MIL-P-14276. For bare metal surface preparation, apply chemical film distinctly iridescent, and/or light yellow to light gold per MIL-C-5541. For touchup repairs of module or chassis abrasion, apply a chromate chemical per MIL-C-5541.

#### 10-34. INSPECTION.

10-35. GENERAL.

10-36. The following paragraphs contain inspection procedures for the disassembled and cleaned equipment. Any portion of the equipment which does not pass inspection should be noted for repair or replacement.

10-37. INSPECTION PROCEDURES.

10-38. Examine covers for deformation, punctures, deep dents, and badly worn surfaces and check for damage to finish. Check chassis for physical damage and deformation, corrosion, and any damage which would require replating or refinishing. Examine connectors for cracked or broken insulation and for contacts which are broken, deformed, or out of alignment. Check also for corroded or damaged plating or contacts, and for loose, poorly soldered, broken, or corroded terminal connections. Examine receptacles for cracked, broken, or charred insulation, and for damage to parts, loose or bent contacts, corrosion, and other conditions.

#### CAUTION

Check to see that the gasket on the radio receiver-transmitter chassis plenum cover is in place and in good condition. The presence and proper condition of this gasket is vital to proper cooling airflow.

10-39. Inspect gears as follows:

- a. Visually inspect all gears. Presence of a sharp burr on one side of the gear at edges of teeth indicates tooth wear. A change in face width due to this burr means that replacement is necessary.
- b. Inspect all gears for broken, chipped, or badly worn teeth.
- c. Inspect gear bodies for cracks and deformation.
- d. Inspect gear bore for excessive wear.
- e. Inspect surfaces for corrosion or other abnormal conditions.

10-40. Inspect ball bearings as follows:

- a. Check for blue or purple discoloration of any part of the bearing due to overheating.
- b. Check for tarnished external surfaces. This is indicated by a light discoloration of the highly finished surfaces.
- c. Check for rust.
- d. Check by noise inspection for flat spots on bearing balls, broken ball separators, flaking or spalling of load-carrying surfaces, and other abnormal conditions.

10-41. Inspect printed circuit boards as follows:

- a. Inspect for loose, broken, corroded, or poorly soldered terminal connections.
- b. Inspect printed circuits for any evidence of damage, such as burned, broken, cracked, or corroded plating.

10-42. Examine fixed-composition and wire-wound resistors for cracked, broken, blistered or charred bodies, and loose, broken, poorly soldered, or corroded terminal connections. Examine variable resistor for corrosion of shafts, cases, and other visible parts, loose mountings, and physical damage.

10-43. Inspect RF coils for broken leads, loose, poorly soldered, or broken terminals, connections, and loose mountings. Also check for crushed, scratched, cut, bruised, or charred windings, leads, terminals, and connections and for physical damage to forms and tuning slug adjustment screws.

10-44. Examine for cold-soldered or resin joints. These joints appear rough, porous, or dull. Examine for excess solder, protrusions from joints, pieces adhering to adjacent insulation, and particles lodged between joints, conductors, or other parts.

**WARNING**

Perform all operations involving the cleaning solvent in a ventilated hood. Avoid breathing solvent vapor, wear a suitable mask when necessary, and avoid continuous contact with the solvent. Use goggles, gloves, and an apron to prevent irritation due to prolonged contact. Change clothing which has become saturated with solvent. Observe all fire precautions for flammable materials. These materials should be used in a hood provided with explosion-proof electrical equipment and an exhaust fan with sparkproof blades. Wear goggles when blowing dust or dirt from equipment parts with air jet. Other persons should be warned away from hazardous area or working enclosure.

10-25. CLEANING MATERIALS.

10-26. Figure 10-6 is a list of cleaning materials. The word solvent in the following paragraphs means a mixture composed of 25 percent methylene chloride, 5 percent perchloroethylene, and 70 percent dry-cleaning solvent. All percentages are by volume. References to an air jet refer to a hand-operated air nozzle supplied with clean, dry, compressed air at a maximum pressure of 28 psi.

10-27. CLEANING PROCEDURES.

10-28. Clean metal surfaces as follows:

- a. Remove dust and dirt from all surfaces, including wiring and small parts, with a soft-bristled brush and air jet.

**NOTE**

When it is necessary to disturb dress of wiring and cables, restore them to their proper positions when cleaning is completed.

- b. Wipe all finished surfaces with a solvent-moistened lintless cloth. Dry and polish these surfaces with a clean, dry, lintless cloth.
- c. Make touchup repairs, if required, to minor damage of the finish.

10-29. Clean connectors and receptacles as follows:

- a. Wipe dust and dirt from bodies, shell, and cable clamps with a solvent-moistened, lintless cloth. Wipe dry with clean, dry, lintless cloth.
- b. Remove dust from inserts with soft-bristled brush and air jet.
- c. Clean dirt and any traces of lubrication from insert, insulation, and contacts with solvent. Apply solvent sparingly with small camel-hair brush.

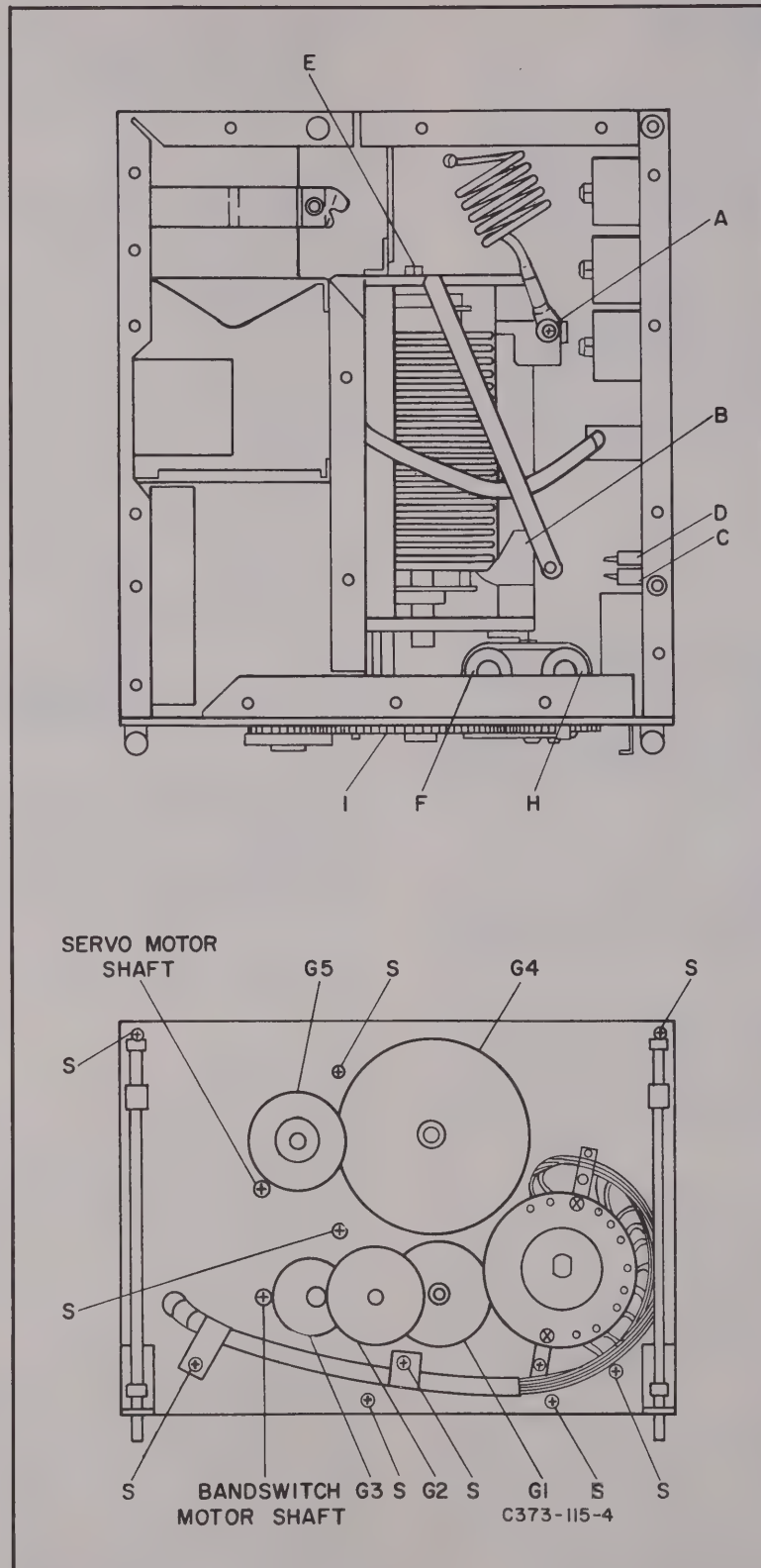
**CAUTION**

Do not allow solvent to run into sleeves or conduit covering any wires or cables connected to contact terminals of the insert. Do not use metal tools to remove foreign matter from these contacts.

- d. Dry inserts with air jet.

MATERIAL	SPECIFICATION	ASO STOCK NO.
Solvent: A mixture by volume of:		
Methylene chloride, 25%	ANA Spec AN-M-37	R51-M-950-20
Perchloroethylene, 5%	Fed Spec O-T-236	R51-T-4459-200
Dry-cleaning solvent, 70%	Fed Spec P-S-661a	R51-C-1326-75
Alcohol	MIL-A-6091A	
Chamois skin		
Cloth, cotton, lintless		
Detergent, powder		
Brush, small, stiff-bristled		
Brush, small, soft-bristled (camel-hair)		

Figure 10-6. List of Cleaning Materials



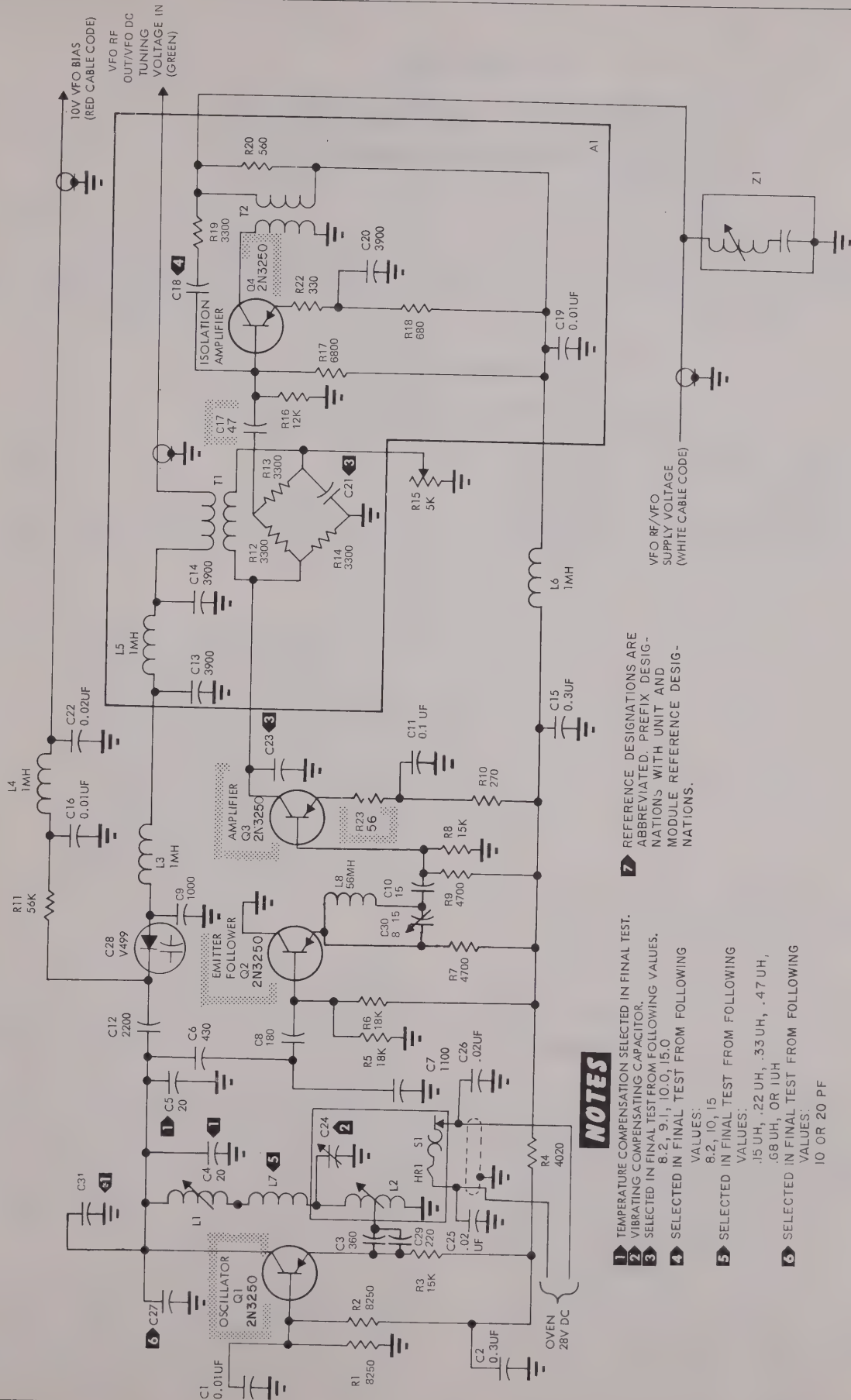
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Figure 10-5. Power Amplifier 2A11, Disassembly Diagram





F4JW/HFC-76



### NOTES

- 1 TEMPERATURE COMPENSATION SELECTED IN FINAL TEST.
- 2 VIBRATING COMPENSATION CAPACITOR.
- 3 SELECTED IN FINAL TEST FROM FOLLOWING VALUES:  
8.2, 9.1, 10.0, 15.0
- 4 SELECTED IN FINAL TEST FROM FOLLOWING VALUES:  
8.2, 10, 15
- 5 SELECTED IN FINAL TEST FROM FOLLOWING VALUES:  
15 UH, .22 UH, .33 UH, .47 UH, .68 UH, OR 1UH
- 6 SELECTED IN FINAL TEST FROM FOLLOWING VALUES:  
10 OR 20 PF
- 7 REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX DESIGNATIONS WITH UNIT AND MODULE REFERENCE DESIGNATIONS.

Figure 8-72. Variable Frequency Oscillator 2A12A2, Schematic Diagram

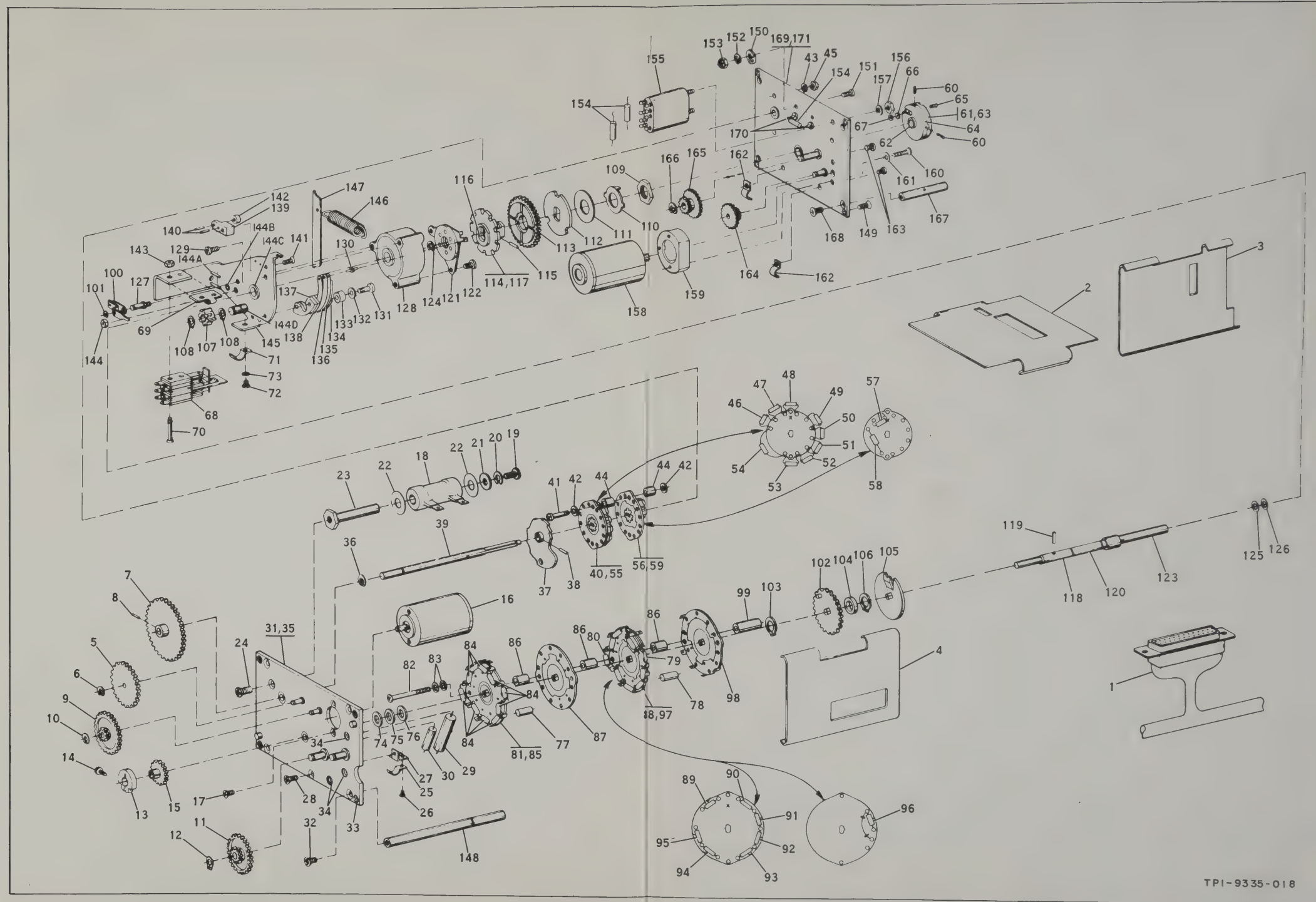


Figure 10-4. Autopositioner 2A12A1, Exploded View

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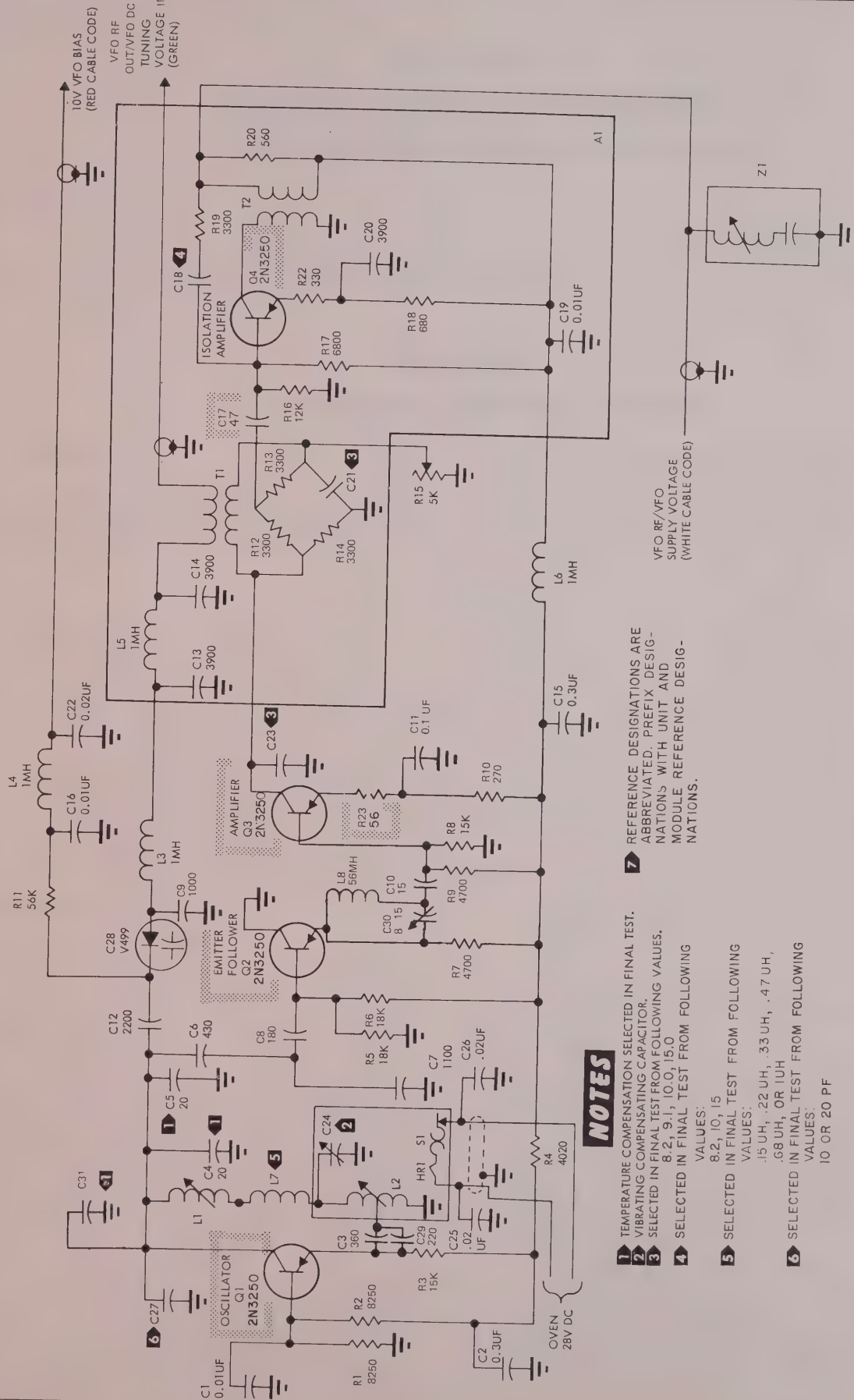


Figure 8-72. Variable Frequency Oscillator 2A12A2, Schematic Diagram

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## SECTION IX

# MAINTENANCE INSTRUCTIONS

## MOUNTING MT-3094/ARC-105

### 9-1. GENERAL.

9-2. Mounting MT-3094/ARC-105 facilitates mounting of Radio Receiver-Transmitter RT-712/ARC-105 in the aircraft. Since the mount has no active mechanical or electrical components, a visual inspection is sufficient for diagnosis of a possible fault.

## SECTION X

# OVERHAUL INSTRUCTIONS

### 10-1. GENERAL.

10-2. This section contains overhaul procedures for the HF Radio Set as follows: dismantling and disassembly, cleaning, inspection, repair and replace-

ment, and reassembly and testing. The instructions are supported by the procedures described in preparation for maintenance, section II, and maintenance instructions, sections VII through IX. Illustrations and tables used in this section are as follows:

Figure	Title	Page
10-1	RF Translator 2A12, Top View . . . . .	10-2
10-2	RF Translator 2A12, Bottom View . . . . .	10-3
10-3	RF Translator 2A12, Gearplate. . . . .	10-4
10-4	Autopositioner 2A12A1, Exploded View . . . . .	10-7
10-5	Power Amplifier 2A11, Disassembly Diagram . . . . .	10-9
10-6	List of Cleaning Materials. . . . .	10-10
10-7	Autopositioner 2A12A1, Alignment . . . . .	10-14
10-8	Autopositioner 2A12A1, Switch Identification. . . . .	10-15
10-9	Autopositioner 2A12A1, Reversing Switch Positioning. . . . .	10-16
10-10	VFO in 500-KHZ Position . . . . .	10-18
10-11	Radio Receiver-Transmitter Lubricants. . . . .	10-18
10-12	RF Translator 2A12, Switch and Turret Alignment . . . . .	10-19

### 10-3. OVERHAUL PHILOSOPHY.

#### NOTE

For field maintenance of antenna coupler, refer to T. O. 12R2-2ARC105-3, Overhaul Instructions, Antenna Coupler CU-1239/ARC-105; all reference to field level maintenance will be disregarded.

10-4. Maintenance includes refurbishment of a module or the complete HF Radio Set. Only the radio set control, power amplifier 2A11, and RF translator 2A12 require detailed disassembly, assembly, and alignment procedures (refer to section VII for disassembly, assembly, and alignment procedures for the radio set control). Procedures for the balance of the HF Radio Set are self-evident.

#### NOTE

Logic blocks A1 through A4 contained in frequency divider 2A1 are nonrepairable and should be replaced if they become faulty. The 3-MHZ crystal oscillator contained in RF oscillator 2A2 and variable frequency

oscillator (VFO) 2A12A2 should be returned to the contractor for repair if they become faulty.

### 10-5. DISMANTLING AND DISASSEMBLY.

#### 10-6. GENERAL.

10-7. Dismantling and disassembly describes the procedures preparatory to overhaul, including dismantling the HF Radio Set into its modules and sub-assemblies and further disassembly into detail parts. Perform only those procedures necessary to disassemble a suspect assembly. Do not completely disassemble a component or assembly as a routine preparation to maintenance.

#### 10-8. REMOVAL OF COVERS, MODULES, AND MODULE COVERS.

10-9. Procedures for removing covers and modules are contained in preparation for maintenance, section II. Removal of radio receiver-transmitter module covers is also described in section II.

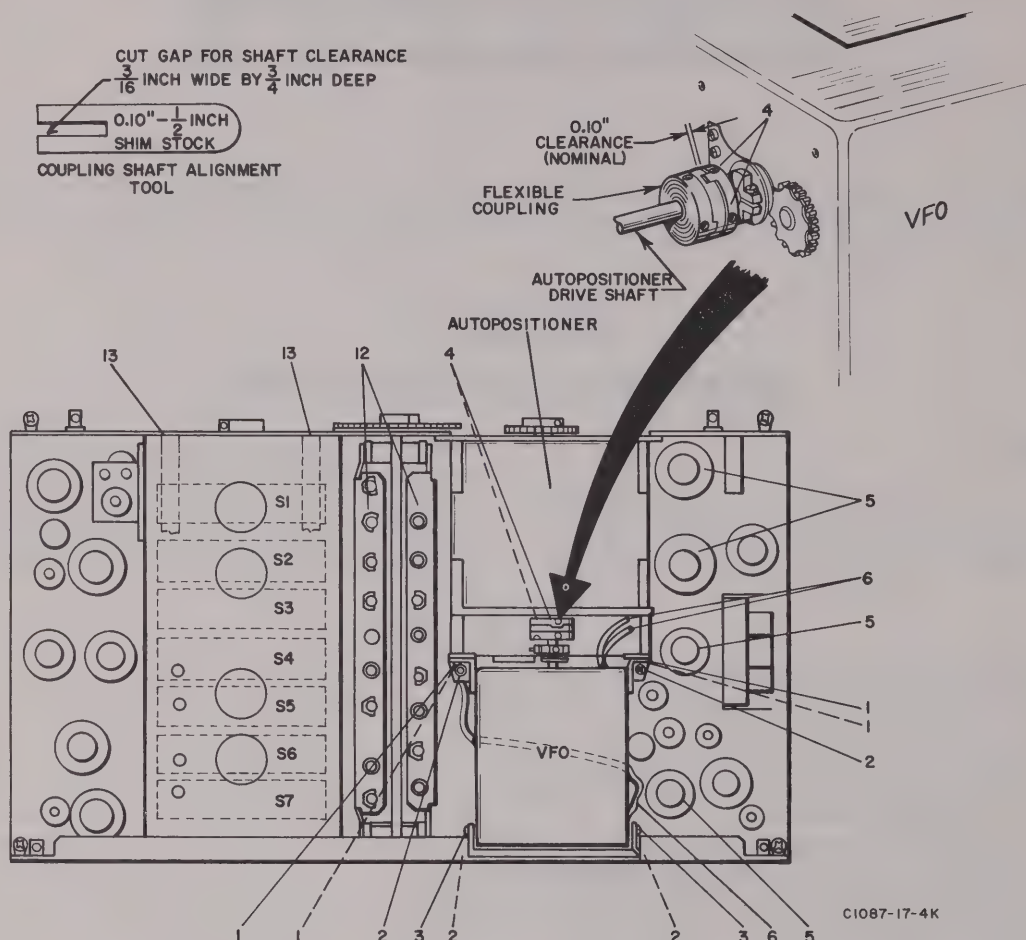


Figure 10-1. RF Translator 2A12, Top View

#### 10-10. DISASSEMBLY OF MECHANICAL ASSEMBLIES.

10-11. Mechanical assemblies are employed in the radio set control (section VII), power amplifier 2A11, and RF translator 2A12. The disassembly procedures for RF translator 2A12 and power amplifier 2A11 are as follows:

10-12. RF TRANSLATOR 2A12. To remove and disassemble the assemblies of RF translator 2A12, perform the procedures of the following paragraphs.

10-13. REMOVAL OF VFO 2A12A2 AND AUTOPOSITIONER 2A12A1. To remove these assemblies, proceed as follows:

a. With RF translator 2A12 in the chassis and power applied to the radio receiver-transmitter, position VFO 2A12A2 and Autopositioner 2A12A1 to 500 KHZ by setting the operating indicator on the radio set control to .500 MHZ, any MHZ band.

b. Remove power, and remove RF translator 2A12 from radio receiver-transmitter chassis.

c. Remove top and bottom covers from RF translator 2A12.

d. Refer to figure 10-1. Remove four screws (1) fastening VFO 2A12A2 to Autopositioner 2A12A1.

e. Remove four screws (2) fastening VFO 2A12A2 brackets to RF translator 2A12 chassis and backplate.

f. Loosen two screws (3) holding back brackets on VFO. Rotate brackets approximately 90 degrees in order to have room to move VFO 2A12A2.

g. Loosen four setscrews (4) on coupler between VFO 2A12A2 and Autopositioner 2A12A1.

h. Remove four tubes (5) adjacent to VFO 2A12A2 and Autopositioner 2A12A1.

i. To remove VFO 2A12A2, tag and unsolder the three leads (6) and the other internal connections in the module. Note placement of these leads on RF translator 2A12A1 chassis. VFO 2A12A2 may then be lifted from RF translator 2A12.

j. Refer to figure 10-2. Remove 3/8-inch flattened shaft (7) directly above 25-pin connector (8) by loosening clamp (9) on gear that drives the shaft. Pull shaft out through gear.

k. Remove two screws (10) holding 25-pin connector to bottom of RF translator 2A12 chassis.

l. Remove idler gear which couples Autopositioner 2A12A1 to slug rack gear. Idler gear is G9 in figure 10-3.

m. Refer to figure 10-3. Remove four screws (11) holding Autopositioner 2A12A1 to gearplate.

n. Carefully maneuver Autopositioner 2A12A1 to free it from mounting plate. Remove Autopositioner 2A12A1 by slowly lifting it from the RF translator 2A12 chassis. Be careful not to damage 28-position switch wafers when pulling 25-pin connector up through chassis.

10-14. REMOVAL OF TURRETS. To remove the turrets, proceed as follows:

a. With RF translator 2A12 in the radio receiver-transmitter chassis and power applied to the radio receiver-transmitter, position turrets to the 2-MHZ position by setting the operating frequency indicator on the radio set control to 2.000 MHZ. Allow radio receiver-transmitter to tune, and remove power.

b. Remove RF translator 2A12 from radio receiver-transmitter chassis.

c. Remove top and bottom covers from RF translator 2A12.

d. Remove turret cover by removing 14 screws on cover.

e. Refer to figure 10-1. Remove two phenolic aligning posts (13) by removing two screws on rear of module. Slide rods out through gearplate.

#### NOTE

If a note referring to the instruction book is found on the side of RF translator 2A12, use a NO 2 Bristol wrench, and loosen setscrews that hold turrets 2A12S1, 2A12S3, and 2A12S7. The module bottom cover illustrates the location of these turrets. Access to the setscrews is through the hole adjacent to the color-coded dot on each turret.

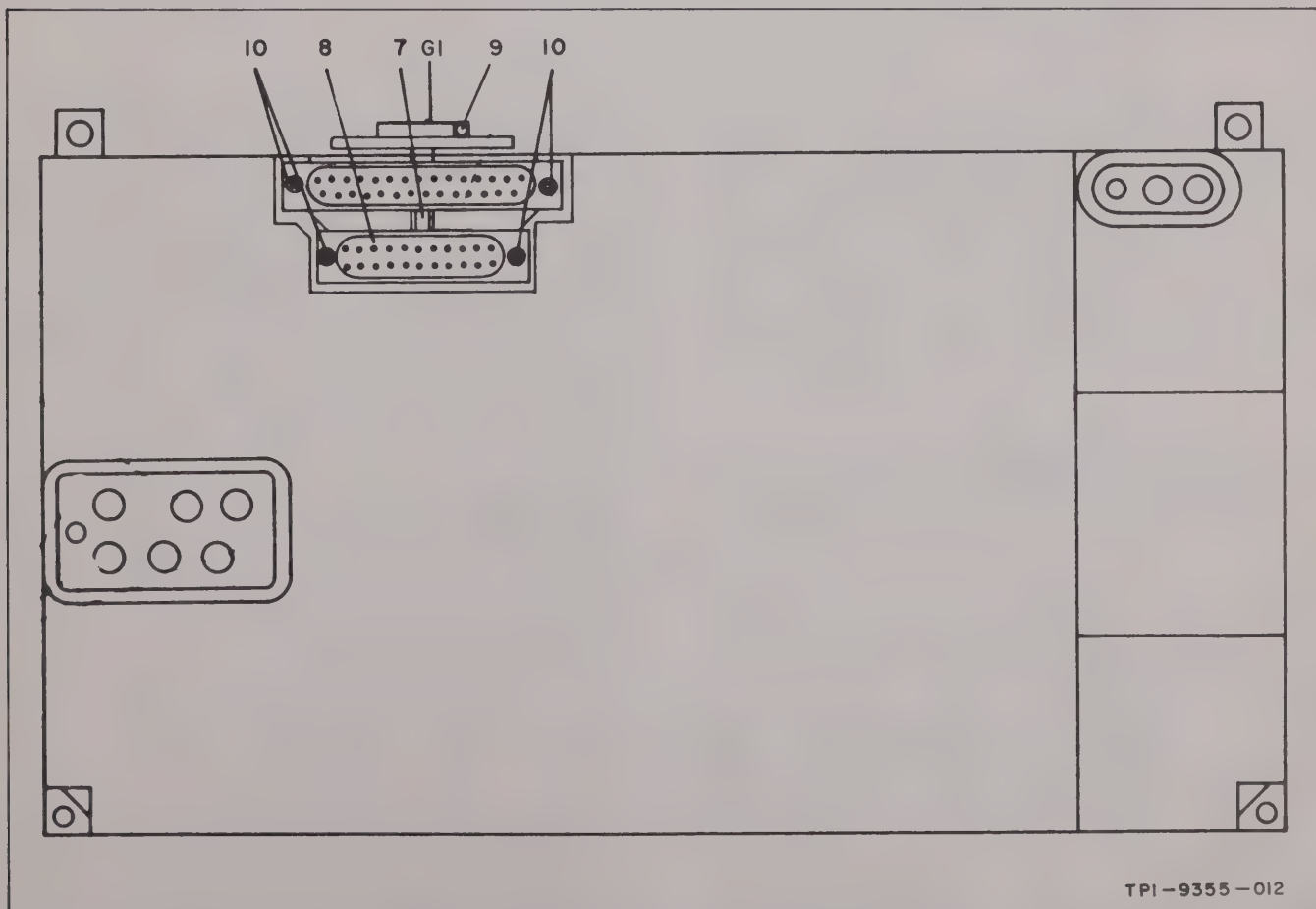


Figure 10-2. RF Translator 2A12, Bottom View

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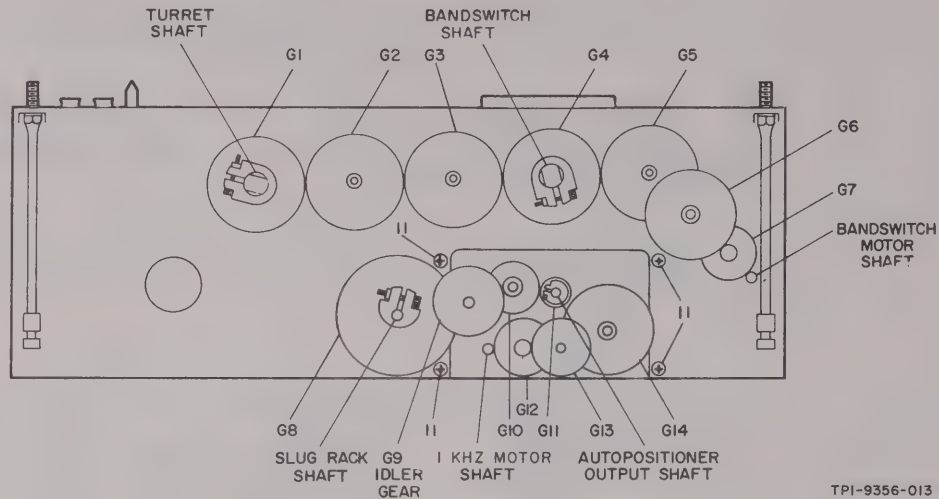


Figure 10-3. RF Translator 2A12, Gearplate

10-15. VARIABLE FREQUENCY OSCILLATOR 2A12A2 DISASSEMBLY. The VFO is a potted assembly. If a fault is definitely traced to the VFO, return it to the contractor for repair or replacement.

10-16. AUTOPOSITIONER 2A12A1 DISASSEMBLY Paragraphs 10-17 through 10-20 discuss removal of detail parts of Autopositioner 2A12A1. Refer to the exploded view illustration (figure 10-4) when performing the disassemblies in these paragraphs.

#### NOTE

Always turn Autopositioner 2A12A1 gears so that control cam (37) rotates in the counter-clockwise direction as viewed from gearplate side of the RF translator chassis.

- 10-17. Remove reversing switch (68) as follows:
- Rotate gear (5) or (9) by hand to position control cam (37) so that cam follower (142) is as near cam-shaft (39) as possible.
  - Remove spring (46) by unhooking spring support (147) that is held in slots on mounting posts (148).
  - Remove VFO coupling shaft (61) from output shaft (120) by loosening two setscrews (60).
  - Remove two cable clamps (162) by removing two screws (163).
  - Remove relay (155) from bearing plate (169) by removing two nuts (156) and two lockwashers (157).

f. Remove DC motor (158) and motor mount (159) from bearing plate by removing two screws (160) and two lockwashers (161).

g. Loosen bearing plate (169) by removing four screws (149). Lift plate straight up to clear output shaft (130) and 1-KHZ switch shaft (39).

h. Remove 1-KHZ switch wafers (40, 55, 56, 59) from bearing plate by removing two screws (41). Be careful not to lose any of the small ceramic spacers (44) and fiber washers (42).

i. Tag any leads before unsoldering from switch terminals. Refer to figure 10-7(B).

10-18. Remove the 10- and 100-KHZ switches as follows: Refer to figure 10-4.

- Perform steps a through g of paragraph 10-17.
- Rotate gear (5) or (9) by hand to position control cam (37) so that screw (9) holding resistor (18) to front plate (31) is accessible.
- Remove screw (19) holding resistor (18) to gearplate. Note placement of resistor leads. Do not lose washers at the ends of this resistor.
- Remove cable clamp (25) by removing screw (26).
- Remove output shaft spur gear (15) by loosening setscrew (14) in clamp (13) and pulling straight off.
- Pull output shaft out of the hole in the gearplate. Be careful not to lose any shim washers between the output shaft and the gearplate. Switch assembly is now free of the Autopositioner chassis.

g. Remove cable clamp (71) by removing screw (72) and lockwasher (73).

h. Remove reversing switch (68) by removing two screws (70).

i. Tag and unsolder the six wires connected to the solenoid (128) and solenoid relay switch block (138). Solenoid relay terminal identification is given in figure 10-7(B).

j. Remove two screws (82) and washers (83) holding switch wafers (81, 85, 87, 88, 97, 98) to mounting plate (145). Switch wafers may now be removed. Tag any leads before unsoldering from switch terminals. Refer to figure 10-8(A).

10-19. Disassemble clutch assembly as follows. Refer to figure 10-4.

a. Perform steps a through f of paragraph 10-18.

b. Bend down tabs on washer (110) under nut (109). Remove nut (109), washer (110), and spring washer (111).

c. Remove clutch disc (112) and spur gear (113).

**CAUTION**

Do not touch clutch surfaces with fingers. Keep surfaces free of dust, dirt, and lubricants of any kind.

10-20. Remove solenoid (128) as follows:

a. Perform steps a through j of paragraph 10-18.  
b. With a punch, remove spring pin (115) through hub of wheel (114) and output shaft (120). Slide notched wheel (114) off shaft.

c. Remove armature (121) from solenoid (128) by removing two screws (122). Be careful not to lose the small fiber actuator (130) that separates armature (121) from solenoid relay contacts (133 through 137).

d. Remove retaining ring (124) from output shaft (120).

e. Unsolder the insulated jumper wire from terminal 2 of solenoid.

f. Remove solenoid (128) from mounting plate (145) by removing two screws (129) and mounting post (127).

10-21. POWER AMPLIFIER 2A11. To disassemble power amplifier 2A11, refer to figure 10-5, and proceed as follows:

a. Remove screw (S) from gearplate.

b. To remove top cover plate from module, loosen 17 screws on cover, slide it toward the gearplate, and lift it off.

c. Remove square plate on end of module opposite gearplate by removing eight screws.

d. Remove two nylon screws (E) and washers holding roller coil assembly to bracket and end of roller coil nearest tubes. Push the screen bypass capacitor out of the way to get at these screws.

e. Remove one screw (A) and washer holding coil to bracket on roller coil assembly.

f. Loosen one screw (B) holding lower strap on roller coil assembly and power resistors (F and H) from terminals (C and D).

g. Pull gearplate (I) out from chassis. Be careful to pull straight out, as band-switch shaft comes out with gearplate. Gear plate (I) will remain connected to module chassis by wiring cable.

**CAUTION**

Short plate straps to chassis with an insulated handle screwdriver before removing tubes.

h. Remove tube cover plate from end of module opposite gearplate by removing six screws. Loosen straps around amplifier tubes. Remove tubes with tube pullers supplied in Electronic Equipment Maintenance Kit MK-825/ARM-86.

**10-22. CLEANING.**

**10-23. GENERAL.**

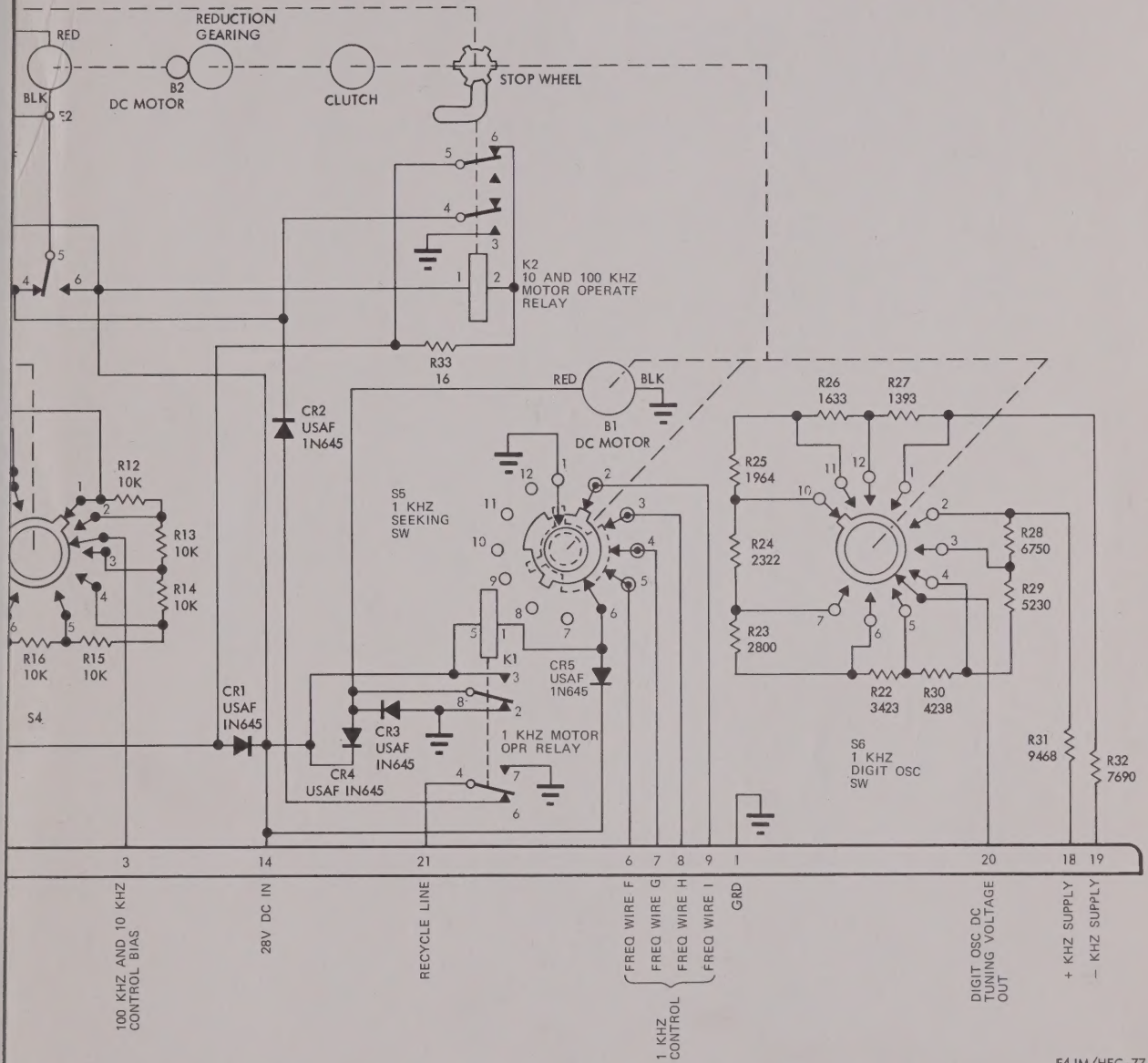
10-24. The following paragraphs contain instructions and procedures for cleaning dismantled and disassembled components, modules, subassemblies, and detail parts.

LEGEND FOR FIGURE 10-4

ITEM	NAME	ITEM	NAME	ITEM	NAME
1	Connector	7	Spur gear	13	Clamp
2	Cover plate	8	Pin	14	Screw
3	Cover plate	9	Gear	15	Spur gear
4	Cover plate	10	Retaining ring	16	DC motor
5	Gear	11	Gear	17	Screw
6	Retaining ring	12	Retaining ring	18	Resistor

## LEGEND FOR FIGURE 10-4 (Cont)

ITEM	NAME	ITEM	NAME	ITEM	NAME
19	Screw	67	Retaining ring	119	Spring pin
20	Lockwasher	68	Reversing switch	120	Output shaft
21	Flat washer	69	Spring clip	121	Armature
22	Washer	70	Screw	122	Screw
	insulator	71	Cable clamp	123	Shaft
23	Electrical-mechanical post	72	Screw	124	Retaining ring
24	Screw	73	Lockwasher	125	Shim
25	Cable clamp	74	Shim	126	Shim
26	Screw	75	Shim	127	Mounting post
27	Cable bracket	76	Shim	128	Solenoid
28	Screw	77	Semiconductor	129	Screw
29	Capacitor	78	Resistor	130	Actuator
30	Resistor	79	Resistor	131	Screw
31	Front plate	80	Resistor	132	Flat washer
32	Screw	81	Rotary switch	133	Spacer
33	Nut	82	Screw	134	Contact
34	Terminal studs	83	Washer	135	Contact
35	Front plate	84	Resistor	136	Contact
36	Retaining ring	85	Rotary switch	137	Contact
37	Control cam	86	Spacer	138	Switch block
38	Spring pin	87	Rotary switch	139	Mounting block
39	Camshaft	88	Rotary switch	140	Spring pin
40	Rotary switch	89	Resistor	141	Screw
41	Screw	90	Resistor	142	Cam follower
42	Fiber washer	91	Resistor	143	Nut
43	Lockwasher	92	Resistor	144	Nut
44	Ceramic spacer	93	Resistor	145	Mounting plate
		94	Resistor	146	Spring
45	Nut	95	Resistor	147	Spring support
46	Resistor	96	Resistor	148	Mounting post
47	Resistor	97	Rotary switch	149	Screw
48	Resistor	98	Rotary switch	150	Terminal
49	Resistor	99	Spacer	151	Nut
50	Resistor	100	Switch pawl	152	Lockwasher
51	Resistor	101	Retaining ring	153	Nut
52	Resistor	102	Gear	154	Semiconductor device
53	Resistor	103	Retaining ring	155	Relay
54	Resistor	104	Washer	156	Nut
55	Rotary switch section	105	Gear	157	Lockwasher
56	Rotary switch section	106	Retaining ring	158	DC motor
		107	Gear	159	Motor mount
57	Resistor	108	Retaining ring	160	Screw
58	Resistor	109	Nut	161	Lockwasher
59	Rotary switch section	110	Washer	162	Cable clamps
		111	Spring washer	163	Screw
60	Setscrew	112	Clutch disc	164	Gear
61	Coupling shaft	113	Spur gear	165	Gear
62	Shaft collar	114	Wheel	166	Retaining ring
63	Coupling shaft	115	Spring pin	167	Post
64	Coupling shaft	116	Clutch	168	Screw
65	Retaining coupling	117	Wheel	169	Bearing plate
66	Flat washer	118	Shaft		



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Figure 8-71. Autopositioner 2A12A1, Schematic Diagram

## LEGEND FOR FIGURE 10-4 (Cont)

ITEM	NAME	ITEM	NAME	ITEM	NAME
19	Screw	67	Retaining ring	119	Spring pin
20	Lockwasher	68	Reversing switch	120	Output shaft
21	Flat washer	69	Spring clip	121	Armature
22	Washer	70	Screw	122	Screw
	insulator	71	Cable clamp	123	Shaft
23	Electrical-mechanical post	72	Screw	124	Retaining ring
	Screw	73	Lockwasher	125	Shim
24	Cable clamp	74	Shim	126	Shim
25	Screw	75	Shim	127	Mounting post
26	Cable bracket	76	Shim	128	Solenoid
27	Screw	77	Semiconductor	129	Screw
28	Capacitor	78	Resistor	130	Actuator
29	Resistor	79	Resistor	131	Screw
30	Front plate	80	Resistor	132	Flat washer
31	Screw	81	Rotary switch	133	Spacer
32	Nut	82	Screw	134	Contact
33	Terminal studs	83	Washer	135	Contact
34	Front plate	84	Resistor	136	Contact
35	Retaining ring	85	Rotary switch	137	Contact
36	Control cam	86	Spacer	138	Switch block
37	Spring pin	87	Rotary switch	139	Mounting block
38	Camshaft	88	Rotary switch	140	Spring pin
39	Rotary switch	89	Resistor	141	Screw
40	Screw	90	Resistor	142	Cam follower
41	Fiber washer	91	Resistor	143	Nut
42	Lockwasher	92	Resistor	144	Nut
43	Ceramic	93	Resistor	145	Mounting plate
44	spacer	94	Resistor	146	Spring
45	Nut	95	Resistor	147	Spring support
46	Resistor	96	Resistor	148	Mounting post
47	Resistor	97	Rotary switch	149	Screw
48	Resistor	98	Rotary switch	150	Terminal
49	Resistor	99	Spacer	151	Nut
50	Resistor	100	Switch pawl	152	Lockwasher
51	Resistor	101	Retaining ring	153	Nut
52	Resistor	102	Gear	154	Semiconductor device
53	Resistor	103	Retaining ring	155	Relay
54	Resistor	104	Washer	156	Nut
55	Rotary switch section	105	Gear	157	Lockwasher
56	Rotary switch section	106	Retaining ring	158	DC motor
	Resistor	107	Gear	159	Motor mount
57	Resistor	108	Retaining ring	160	Screw
58	Resistor	109	Nut	161	Lockwasher
59	Rotary switch section	110	Washer	162	Cable clamps
	Setscrew	111	Spring washer	163	Screw
60	Coupling shaft	112	Clutch disc	164	Gear
61	Shaft collar	113	Spur gear	165	Gear
62	Coupling shaft	114	Wheel	166	Retaining ring
63	Coupling shaft	115	Spring pin	167	Post
64	Coupling shaft	116	Clutch	168	Screw
65	Retaining coupling	117	Wheel	169	Bearing plate
66	Flat washer	118	Shaft		

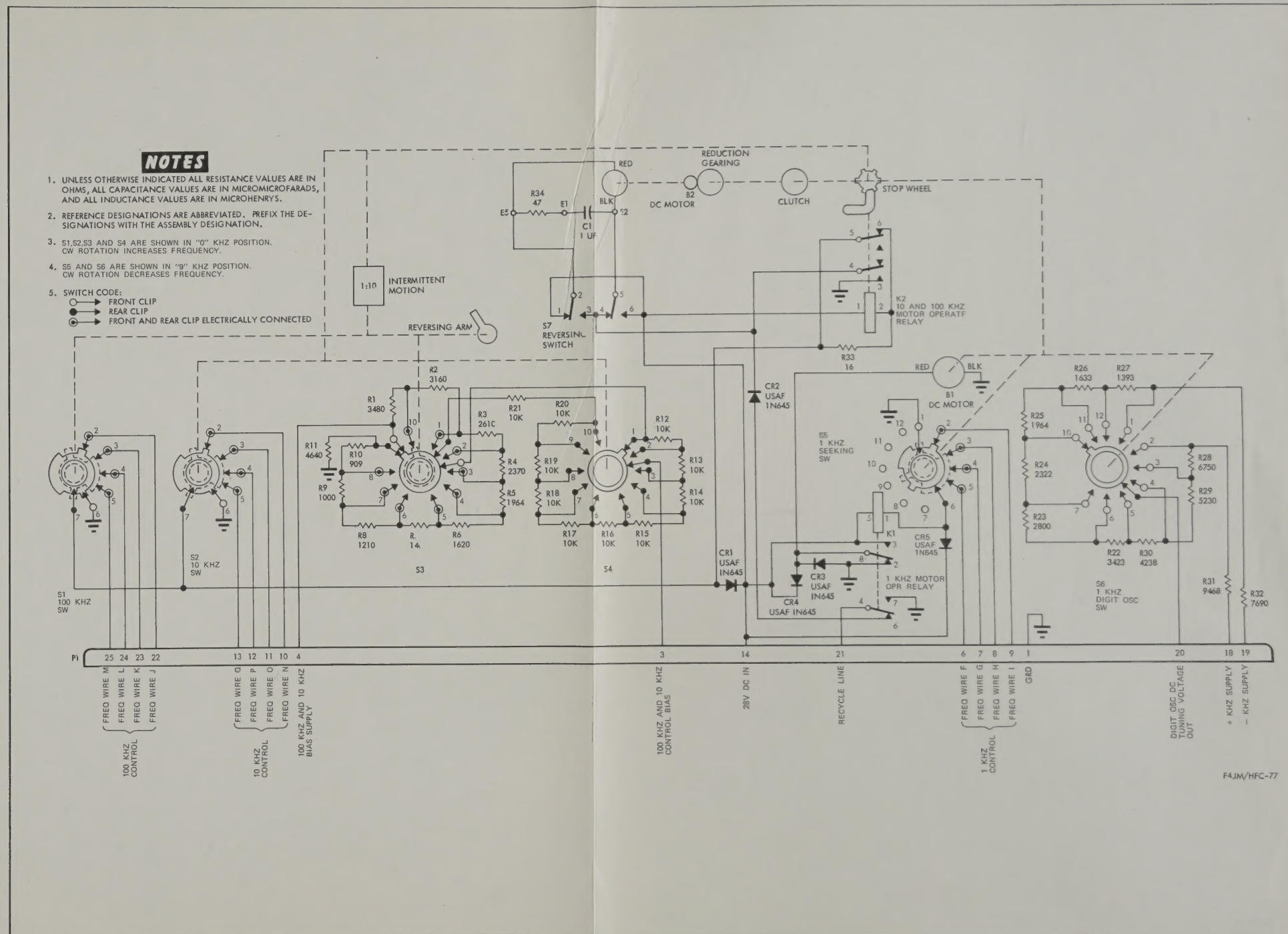


Figure 8-71. Autopositioner 2A12A1, Schematic Diagram

